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VOL. CLIV.—No. 3992] LONDON: FRIDAY EVENING, JULY 15, 1932 [PRICE { WITH INDEX AND OTHER SUPPLEMENT } 1s. 6d. BY INLAND POST 1s. 9d.

PUBLIC NOTICES.

Computer Class II.
(Male or Female), REQUIRED for the Ordnance Committee, Royal Arsenal, Woolwich, S.E. 18. Candidates must have mathematical qualifications equivalent to London University Intermediate Examination. Age 21-35. (Service in His Majesty's Forces may be deducted.) Post is pensionable, subject to probation not exceeding two years. Preference to ex-Service candidates. Commencing salary (including bonus): males, £172; females, £147.—Application form from SECRETARY, above address, to be returned not later than 22nd July. 8765

Heriot-Watt College, Edinburgh
DEPARTMENTS OF MECHANICAL ENGINEERING AND ELECTRICAL ENGINEERING.
MECHANICAL ENGINEERING:
PROFESSOR A. R. HORNE, O.B.E., B.Sc., M.I. Mech. E., A.M.I.C.E.
ELECTRICAL ENGINEERING:
PROFESSOR F. G. BAILY, M.A., M.I.E.E.
FULL-TIME DAY DIPLOMA COURSES leading to professional recognition.
CLASSES COMMENCE 11th OCTOBER.
Full particulars from the College.
J. CAMERON SMAIL, O.B.E., F.E.S.E., Principal. 8690

University of Birmingham.
DEPARTMENT OF MECHANICAL ENGINEERING.
The Trustees of the James L. Norton Memorial Fund invite the APPLICATION of either Graduates of the Institution of Automobile Engineers or holders of Honours Degrees in Engineering for the JAMES L. NORTON STUDENTSHIP, value £100 (one hundred pounds), for one year.
The successful applicant will be required to devote his whole time to the study of Automobile Engineering problems connected with the motor cycle and will be required to produce a thesis at the end of the year embodying the results of the investigations, which may be experimental or alternatively a study of the state of the motor cycle engineering industry as a whole.
Applicants should send their qualifications to the REGISTRAR of the UNIVERSITY not later than July 19th, 1932. 8738

Borough of Swindon Education Committee.
THE COLLEGE
(COLLEGE FOR FURTHER EDUCATION).
APPLICATIONS are INVITED for the POST of PRINCIPAL. Candidates must be graduates of a British University and must have had suitable experience in technical education and also in industry (preferably mechanical engineering). Salary £750 per annum, less 10 per cent.; no scale fixed. It is desired that the gentleman appointed shall take up duty as soon as possible.
Form of application, to be obtained by forwarding stamped addressed foolscap envelope, should be returned to the undersigned at the Education Office, Clarence-street, Swindon, not later than 21st July, 1932.
STANLEY HIRST,
8735 Director of Education.

Hong Kong
TECHNICAL SCHOOL.
PRINCIPAL REQUIRED as soon as possible for a new Technical School comprising a Junior Technical School and Evening Classes for trade apprentices, with special reference to Engineering.
QUALIFICATIONS.—A good general and technical education; workshop experience; teaching and administrative experience in a Technical Institution. The Principal will be expected to act as adviser on Technical Education to the Director of Education.
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SALARY.—£850 per annum.
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Further information and forms of application can be obtained from the Secretary (SIR/CA), Board of Education, Whitehall, London, S.W. 1. Candidates who are at present employed in Scotland should apply to the SECRETARY, Scottish Education Department, Whitehall, London, S.W. 1. The list of applications will close on 22rd July, 1932. 8752

County Mental Hospital, Prestwich, Manchester.
HEATING AND HOT WATER SUPPLY INSTALLATIONS.
The Committee of Visitors invite TENDERS for complete CENTRAL HEATING and HOT WATER SUPPLY INSTALLATIONS, including STEAM BOILER PLANTS, PUMPS, CALORIFIERS, &c., to be erected at the Prestwich Mental Hospital, Prestwich, Manchester, in accordance with the plans and specifications prepared by the Committee's Consulting Engineer, George W. Martin, M.I. Mech. E., M. Cons. E., 33, Arran-road, Catford, London, S.E. 6, which may be seen at the Hospital or the Consulting Engineer's Office before payment of fee.
Applications for copies of the plans and specifications must be made to the Consulting Engineer as above or the Clerk and Steward of the County Mental Hospital, Prestwich, NOT LATER than July 22nd, 1932, and must be accompanied by a fee of Five Guineas, which will be returnable on receipt of a bona fide Tender which is not subsequently withdrawn. (Cheques to be made payable to the Clerk and Steward, Prestwich County Mental Hospital.)
Tenders, endorsed "Central Heating—Prestwich Hospital," must be sent in not later than Twelve Noon on Monday, the 15th August, 1932, to the Chairman of Committee of Visitors, County Mental Hospital, Prestwich, Manchester.
The Committee do not bind themselves to accept the lowest or any Tender.
Dated this 15th day of July, 1932.
GEORGE ETHERTON,
Clerk of the Committee.
County Offices, Preston. 8767

The Civil Engineers Appointments Board, 8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.
All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training, and experience. P2183

The Engineer

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SITUATIONS OPEN.

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TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.
For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

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The Engineer

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This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

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Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

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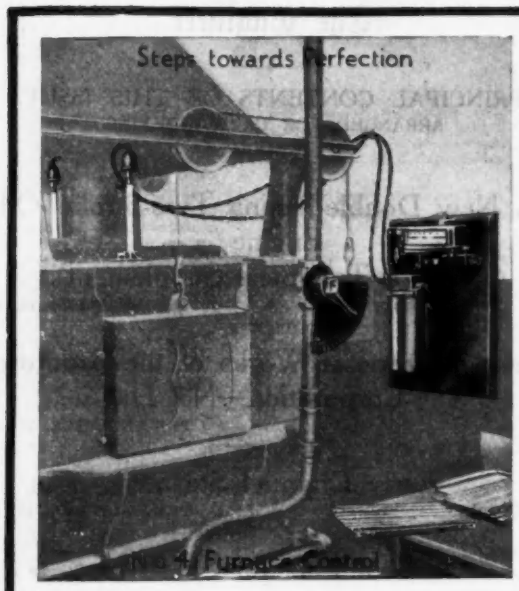

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A Seven-Day Journal

The New Engineer-in-Chief of the Fleet.

ACCORDING to an Admiralty announcement of Friday last, July 8th, Engineer Rear-Admiral Harold A. Brown, M.I. Mech. E., has been appointed to be Engineer-in-Chief in succession to Engineer Vice-Admiral Sir Reginald W. Skelton, the appointment to date from December 1st, 1932. Engineer Rear-Admiral Brown has been Deputy Engineer-in-Chief since April, 1930, and has had previous service at the Admiralty, including a period during the early stages of the war. He was commissioned as an Assistant Engineer in July, 1900, and served as such in the cruiser "Arrogant" in the Channel Squadron. During the war he was engineer officer of the cruiser "Penelope" and the battleship "Barham" in the Grand Fleet. Before his promotion to Engineer-Captain in 1924 he was Assistant Naval Attaché at Washington. In April, 1927, he was made Assistant Engineer-in-Chief at the Admiralty and afterwards served as Fleet Engineer Officer on the staff of Vice-Admiral Sir Ernle Chatfield in the Atlantic Fleet. At the last Annual General Meeting of the Institution of Mechanical Engineers Engineer Rear-Admiral Brown was elected a member of Council. In the same Admiralty announcement reference is made to the appointment of Mr. T. B. Hunter, M. Inst. C.E., Deputy Civil Engineer-in-Chief, to be Civil Engineer-in-Chief in succession to Sir L. H. Savile, M. Inst. C.E., to date from September 1st, 1932.

The Late Sir Richard Threlfall.

WE regret to have to announce the death, at his home at Edgbaston, of Sir Richard Threlfall, the chemist and engineer. He was born in August, 1861, and was therefore nearly seventy-one years of age at the time of his death last Sunday, July 10th. He was educated at Clifton and at Caius College, Cambridge, of which he was elected an honorary fellow in 1904, and was appointed Professor of Physics in the University of Sydney, N.S.W., at the age of twenty-five. In 1896 he was called upon to be Chairman of a N.S.W. Royal Commission to investigate the causes of the spontaneous combustion of coal in ships, particularly in the cargoes of sailing ships. The war, combined with his proved abilities, caused him to receive numerous appointments. He was a member of the Board of Invention and Research in 1915. The year 1916 found him on the Munitions Invention Board and the Advisory Council for Scientific and Industrial Research. He became a member of the newly instituted Fuel Research Board in 1917 and on the retirement of Sir George Beilby in 1923 succeeded him as Chairman. Membership of the Chemical Warfare Committee in 1917 and of the Food Preservation Board in 1918 were also among his appointments. He was a director of the chemical manufacturing firm of Albright and Wilson, and published a number of papers on chemical and physical subjects. Some of his experiments on the properties of matter under very high pressures and temperatures will be remembered by engineers.

The King's Cup Air Race.

THE King's Cup Air Race, which took place last Friday and Saturday, July 8th and 9th, was won by Captain W. L. Hope, who secured the prize in 1927 and 1928. He was flying a Fox Moth fitted with a Gipsy III. engine, and his average speed over the 1233 miles of the course was 124·25 miles per hour. This speed was about 10 m.p.h. more than the machine was thought to be capable of making, and cannot be accounted for only by the installation of the new type Gipsy III. engine, which is believed to be rated at 135 H.P. against the 120 H.P. of the original engine. The speed of the Avro Mail Carrier, piloted by Mr. H. A. Brown at 176 m.p.h., was 5 m.p.h. faster than the previous best time for the race. The reliability of modern aircraft, even when tuned to racing pitch, is illustrated by the fact that out of the forty machines which started on Friday, thirty-six completed the first day's part of the flight. One of these machines was disqualified, and another retired, leaving thirty-four to start on the Saturday, out of which number thirty-three finished.

The Loss of the French Submarine.

WE deplore the loss of the French submarine "Prométhée" and her crew of sixty-two men just as much as we do the loss of our "M 2" in Portland Bay. Neither of these disasters seems likely to lead to much progress in the science of submarine navigation. There is, however, the prospect that some technical information as to the happenings which preceded the foundering may be available in the case of the French vessel, as the commander, together with several other men, was rescued. The "Prométhée" sank on July 7th, when she was, apparently, carrying out ordinary surface evolutions. The accident occurred off Cape Levi, on the north coast of France, and the vessel lies under about 250ft. of water. It is said that she went down by the stern, and explorations carried out by the divers of the famous salvage ship "Artiglio" confirm that probability, for they found the forward hatches shut, whilst that further aft, leading to the officers' quarters, was jammed open. Efforts are being made to raise the wreck by, it is said, direct lifting, but the local conditions are, at least, as difficult as those of salving our "M 2," although the water is not so deep. We are informed that Mr. E. F. Cox, of Cox and Danks, Ltd., has been called to Paris to consult with the Minister of Marine as to the means to be adopted for raising the ship.

Miss England III.

ON Tuesday evening, July 12th it was formally announced by the Marine Motoring Association of Great Britain that Mr. Kaye Don's attempt on the national and world water speed records in Lord Wakefield's speed boat "Miss England III." on Loch Lomond had been postponed. It is understood that some days will be necessary for the boat builders, John I. Thornycroft and Co., Ltd., and the engineers, Rolls-Royce, Ltd., to make certain adjustments and improvements and to carry out preliminary trials before the boat is ready for a final run. The small alteration in the angle of the forward plane, which we referred to in last week's Journal note, was successfully carried out over last week-end, and early this week the boat ran smoothly at high speeds within a few miles of the record speed it is desired to exceed. The trials showed, however, that some adjustment must be made to the water scoops, which take in the engine cooling water, and arrangements are being made for this work to be done during the next few days. An occurrence which delayed the progress of the trials was the collapse of the slipway and the derailment of the cradle carrying the boat, which took place on Monday last. We are able to state, however, that the accident did not do any material damage to the hull of the boat and that the slipway has been satisfactorily reconstructed by laying down new rails with the help of divers from the Admiralty torpedo depôt at Loch Long.

Electrification on the Danish State Railways.

ON Thursday, July 7th, Mr. Ove Munck, the Chief Mechanical Engineer of the Danish State Railways, signed a contract with the English Electric Company for the first electrification scheme to be undertaken on that system. The suburban services of Copenhagen are to be converted to electric working at a D.C. pressure of 1500 volts, and the English Electric Company will be responsible for the complete electrical equipment for forty-two motor coaches and twenty-one trailer coaches. The contract was obtained in open competition with fourteen of the principal firms in Great Britain and on the Continent, and the placing of the order with a British firm can be regarded as an indication of the Danish Government's faith in British goods. By the award of the contract the number of countries in which English Electric railway equipments are operating has been brought up to seventeen, and when the Danish system is in operation fifty-six railways of the world will have been electrified with the company's material. The first high-voltage D.C. line to be put into service was the Bury-Holcombe Brook route, of the Lancashire and Yorkshire Railway, for which the English Electric Company developed 3600-volt motors as far back as 1913.

The World Shipping Position.

ON Friday of last week, July 8th, the whole position of world shipping was reviewed in London by the Standing Committee of the International Shipping Conference. Representatives from the principal European countries, also Japan and New Zealand, were present, in addition to representatives of the International Maritime Conference and an observer from the United States Shipping Board. Agreement was reached on the general question of shipping policy, and the immediate steps to be taken to relieve the existing position created by the overwhelming excess of tonnage were examined in detail and were referred for further consideration to the national associations. The recommendations of the Standing Committee to the International Shipping Conference include adherence to the policy of the freedom of the seas on a footing of equality for all ships operating on an economic basis under all flags, in all ports, and in all international trades, and the starting in co-operation with all interests concerned of such laying-up or scrapping schemes as may be necessary to bring tramp and liner tonnage into relation with the needs of overseas trade, and generally to promote the employment of such tonnage to the best account.

Trial Flight of Large Flying Boat.

ON Monday, July 11th, the great six-engined flying boat built by Short Brothers, and launched rather more than a fortnight before, demonstrated its qualities in a trial flight over the Medway. The machine, fully loaded, weighs 33 tons. It is a biplane fitted with six Rolls-Royce Buzzard engines, each giving 825 H.P. The engines are placed in tandem pairs between the wings, so that there are in all three tractor and three pusher air screws. The wing span is 120ft., and the total height 30ft. 4in. The tail is of monoplane construction, the rudder being single. The machine is constructed principally in duralumin; but parts below the water line are made of stainless steel. The hull is 89ft. 6in. long and the forward part is fitted with portholes and provides spacious quarters for the crew of ten. There are four machine gun cockpits. One is in the bows forward of the pilot's cabin and another aft of the tail. The other two are placed amidships, one on each side. The petrol tanks are carried in the upper wing and are of sufficient capacity to give the machine a long range. On Monday the flying boat was not fully loaded, but even so it was a creditable performance to get the machine into the air 13 sec. after the beginning of the take-off. The machine demonstrated on the water its ease of control, circling to port and starboard and answering the rudder readily, even when running across the 20 m.p.h. wind that was blowing. Major H. G. Brackley, air superintendent of Imperial Airways, who accompanied the pilot, Mr. J. Lankester Parker, on the flight, declared that the boat was as easy to control as the Kent type, which is well known to be easy to fly.

The Late Admiral Sir R. F. Henderson.

ADMIRAL SIR REGINALD FRIEND HENDERSON, who died at his home, Felder House, Worth, Kent, on Tuesday last, July 12th, at the advanced age of eighty-five, had a distinguished career in the Royal Navy, in which he served from 1860 to 1910. He was commissioned lieutenant and served in the screw frigate "Phœbe" in 1869. In 1881 he was promoted to commander from the battleship "Superb" and was second in command in the "Invincible" at the bombardment of Alexandria, serving later on land with the armoured trains. He became captain in 1888 and after serving with the battleship "Severn" on the China Station he took command of the battleship "Royal Sovereign" in the Channel Squadron in 1895. In 1898 he was given charge of the Dockyard Reserve at Portsmouth, and his success in this office paved the way for his appointment in 1899 as Captain-Superintendent of Sheerness Dockyard. In 1902 he became Admiral-Superintendent of Portsmouth Dockyard and three years later was selected for the post of Admiral Commanding Coastguard and Reserves. He retained this position until 1910, when he went to Australia to advise the Commonwealth Government on the creation of the Royal Australian Navy. He served on several committees and commissions, including the Royal Commission on Oil Fuel and Oil Engines for the Navy. For many years he edited the "Naval Review," the journal of the Naval Society (1912).

Salving the M 2.

FURTHER progress was made during last week-end in the preparations for raising the sunken submarine "M 2," but it seems likely that some few weeks will elapse before final lifting will begin. The naval vessels in attendance last week included the mooring lighters, the "Moordale" and the "Steady," the salvage ship "Tedworth," and the tugs "St. Mellons" and "Pilot." Operations were directed from the "Alecto," under the Rear-Admiral in Command of Submarines, and Mr. E. F. Cox, of Cox and Danks, Ltd., was also present. After sealing up the vessel, air was pumped into her to increase her buoyancy, and the bow was raised, the lifting effect being assisted by two lifting pontoons, each of 80 tons capacity. On Monday morning last, one of these pontoons suddenly broke adrift, and owing to its buoyant condition rose violently to the surface of the water. This pontoon will be replaced and two further pontoons added, while an additional air compressor will also be brought into service to supply the extra amount of air required. The bow of the submarine rose about 18ft. before the pontoon broke away, but water was found to be freely entering some of the torpedo tubes. When the divers have sealed the leaking torpedo tubes in the fore part of the hull, a further attempt to lift the submarine will be made, probably in two to three weeks' time.

The Bursting of the Shyok Ice Barrier.

AT 3 a.m. on Monday last, July 11th, a part of the Shyok glacier, nearly a quarter of a mile in thickness by over 400ft. in height, which forms a natural dam, burst, allowing water to pour down the Shyok gorge and flood the rivers Shyok and Indus. At Leh on the Indus the water level rose almost immediately to 50ft., but dropped to 40ft. within one hour and to 2ft. 6in. at five o'clock the same evening. The authorities in Simla assume that the breach in the dam was almost immediately closed by ice movements and that the low state of the rivers caused by lack of rain will prevent serious flooding, such as took place in 1929. At Bunji the Indus rose on Tuesday last to 30ft. above normal level, increasing 22ft. in three hours and dropping to 19ft. above normal level at midnight, returning to normal the next morning. Fear was entertained of the effect of the flood water on the Attock Bridge, some 600 miles below the Shyok dam and for the Sukkur barrage, some 300 miles lower down. It appears that, although the flooding may be less serious than at first expected, great vigilance will need to be exercised until all danger has passed.

The Sewage Disposal Works of the Bradford Corporation.

No. I.

As was briefly announced in our Annual Article on Sanitary Engineering, which was published in January, the Esholt sewage disposal works of the Bradford Corporation, though they are not yet entirely completed, are sufficiently nearly so to treat the whole of the sewage draining to them. A termination has thus nearly come to a great undertaking which has been in progress for nearly fourteen years.

We propose to give a full description of these interesting disposal works in the following article, but before we do so it will be of interest to record the special difficulties in the treatment of its sewage which Bradford has had to face, and which it has satisfactorily overcome. In the early days, when the population was small, the sewage simply found its way into watercourses and the Bradford Beck and its tributaries, and, for some considerable time, no great harm or inconvenience was experienced. With the coming of factories and the considerable growth in population, which resulted, conditions were entirely changed, and for a long while—as in many other places—it was not realised what the full effect of those changed conditions was. Matters were allowed to continue in the same state as before, and far into the nineteenth century the sanitary condition of Bradford is described as being "deplorable." An experienced Government officer, who was engaged in collating the material which eventually resulted in the passing of the Public Health Act of 1848, described it as "the most filthy town I have visited." There was not a public sewer in the place. Much of the sewage found its way into a stagnant branch of the Leeds and Liverpool Canal and the water in the latter was said to be so charged with decaying matter that in hot weather bubbles of sulphuretted hydrogen were continually rising to the surface and could, actually, be set alight. The air was, in fact, so charged with the gas that "watch cases and other materials of silver became black in the pockets of the workmen employed near the canal." Fevers prevailed all around. That was in 1843—barely ninety years ago.

Matters became more and more serious, and in 1853 the then borough surveyor, Mr. Charles Gott, M. Inst. C.E., laid down the line for a main trunk sewer. It was not until nine years later, however, that any progress was made with its construction, but, by 1870, some 30 miles of sewer had been laid. The work of sewering has proceeded continuously ever since, and now there are no less than 118 miles of sewers in the area of the old borough, in addition to which the Bradford Beck was, in 1866, covered over in that part of it that traversed the town, and the Canal Basin trouble first of all ameliorated and the basin itself eventually done away with.

The measures of improvement taken, however, were all based on the idea that the river Aire was the natural outlet by which the untreated sewage should be got rid of, and the more efficient the drainage of the town the worse became the condition of the Bradford Beck and of the river Aire into which it flowed, and the worse were the complaints of the riparian owners further downstream. Conditions were made even worse by the fact that other industrial communities, which were rapidly springing up on the banks of the river, were also using the river for the disposal of their sewage.

To add to the troubles and complications of the problem, the woolcombing industry, about the middle of the nineteenth century, developed with extraordinary rapidity in the town, and it added enormously to the difficulties which had to be surmounted. Wool and hair were, and still are, taken to Bradford in enormous quantities from all over the world in the crude state in which they are clipped from the backs of the animals. Before being combed, the wool is washed, and in that process it loses in many cases as much as 60 per cent. of its weight, that 60 per cent. consisting partly of natural animal fat and partly of the dirt and manure clinging to the fleeces. As a consequence, the effluent from the wool-combing vessels is extremely "rich" in organic substances, and it is also offensive. As showing the magnitude of the problem which the trade creates, it may be pointed out that no less than a fifth of the total quantity of wool produced in the whole world, or four-fifths of the amount grown in or imported into England, is washed and dealt with in the Bradford area.

We cannot spare space to follow in detail the efforts which were made to overcome the difficulties which the presence of this large proportion of animal grease—which is known, in its refined state, under the name of lanoline—in the sewage occasioned. It may be said, however, that a still further complication arose from the fact that the effluents from many dyeworks were poured into the sewers, so that, at one time, the sewage might run acid, and at another strongly alkaline. For a time lime was employed to precipitate the solids, the effluent being filtered through coke breeze. Then, ferric sulphate was used, but as it proved very expensive, finally, in 1901, sulphuric acid was tried and was found to be successful, in that it brought about the precipitation of the solids. It still remained, however, to dispose of the sludge and to remove the grease, and how that was successfully accomplished had best be explained when we come to discuss the full method of sewage disposal as it is carried out at the present time.

The original experiments for the de-greasing of the sewage were carried out on a site at Frizinghall, which is the lowest land within the borough. The site was extended, but eventually it proved inadequate, and it was necessary to search in another direction in order to find a locality that would be suitable from all points of view for the purpose of constructing a sewage disposal works which would not only serve present requirements, but be capable of future extension. At length the Esholt estate, which borders the river Aire, was purchased in 1906 for a sum of very nearly £240,000. A scheme for the utilisation of the whole estate was got out by the late Mr. Joseph Garfield, M. Inst. C.E., the then sewage works engineer, the estimated cost being £955,000, but it was not till April, 1909, that the project was finally sanctioned by the Local Government Board. Thenceforward the work of carrying it out proceeded continuously, but so extensive was it that only now is it approaching completion.

The area of the City of Bradford is 24,625 acres, 20,156 acres of which drain to the new Esholt works in the Aire Valley, while most of the remainder drains to what are known as the North Bierley works, which are in the Calder Valley. There are, however, one or two small portions of the city which, as a matter of convenience, drain to the works of outside authorities. In addition to the area of Bradford which drains to the Esholt works, there are (*a*) an area of 1110 acres belonging to the Yeadon Urban District Council and an area of 1340 acres belonging to the Baildon Urban District Council which also drain there, those Councils having entered into agreements with the Corporation, whereby the sewage from those areas will be treated for a period of years.

The population of the city was, according to the census of 1931, 298,000 persons, and it is taken that the sewage of 273,000 of that total is dealt with at Esholt, as well as that from 7000 persons in the township at Yeadon, and 7400 persons in the township of Baildon—so that the sewage from a total of 287,000 persons is, at the present time, being dealt with at that place. The dry weather volume of crude sewage flowing daily to the new works at that place is, as shown by gauges, approximately as follows :—

	Million gallons
From the central part of the city	15
From the Eccleshill and Idle districts of the city	1
From Yeadon	1¼
From Baildon	¾
Total	18

Hence, the dry weather flow of crude sewage amounts to as much as 63 gallons per head of the population per day. In wet weather, of course, the volume is greatly increased, and a figure of as much as 96 million gallons a day has been reached on many occasions. The average flow throughout the year, however, is—to take the year 1929–30 as an example—23¾ million gallons daily, the total flow for that year being 8,661,000,000 from Bradford alone, without counting outside districts. A distinguishing feature of the flow of sewage from the city is the high rate which is maintained during the working hours of the day, as is shown by the curve given in Fig. 1, from which it will be seen that a very high rate of flow persists between the hours of 10.30 in the morning and 5.30 in the evening. The reason for this long-continued high rate is, mainly, the emptying of wash-bowls and vats at the various wool-washing and dyeing plants in the city.

The sewage draining to Esholt is, approximately, half domestic and half trade waste. The latter consists of crude wool scouring effluents, soak tank effluents from wool-scouring treatment plants, and various dye liquors. Typical characteristics of wool-scouring liquors are as follows :—

Wool-scouring Effluent.

	Parts per 100,000.
Grease	2220·0
Suspended matter	3030·0
Oxygen absorbed	234·0
Alkalinity	612·5

Treated Wool-scouring (Soak Tank) Effluent.

	Parts per 100,000.
Grease	144·0
Suspended matter	315·0
Oxygen absorbed	117·9
Acidity	102·9

The dye liquors are exceedingly varied, some being acid and some strongly alkaline, according as to whether they are from the wool, cotton, or silk industries. The strength of the combined liquors—that is to say, the crude sewage as it arrives at the disposal works—is indicated by the following figures, which are an average taken over twelve months :—

Crude Sewage Arriving at Esholt.

	Parts per 100,000.
Grease	89·0
Suspended matter	145·0
Oxygen absorbed	24·6
Alkalinity	81·5

The difficulty of treatment is not, however, to be measured by the consideration of average figures, because, owing to the nature of the staple industries of the city, the sewage during the working day contains a higher proportion of trade waste than at other times, and the "oxygen absorbed" figure is often double that just quoted. By painstaking study and perseverance, however, the problem of dealing with this troublesome sewage has been most successfully solved, and the effluents from the Corporation's treatment works leave nothing to be desired.

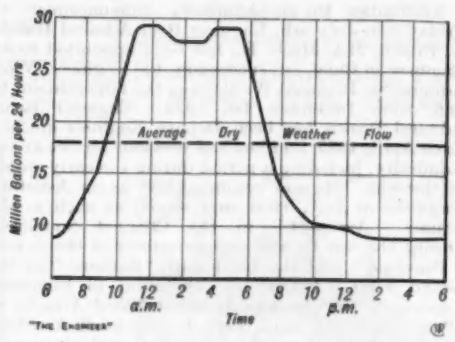


FIG. 1—HOURLY RATE OF FLOW

The Esholt Site.

The area of the Esholt estate is some 1900 acres, of which about 800 are available for sewage disposal by gravitation. The site is ideal from nearly all points of view, and there were only two drawbacks. The first was that the difference in level between the city and the works was not very great, so that in order to obtain sufficient fall for the satisfactory flow of sewage it was necessary to drive a tunnel, which is just over 4800 yards long, under high ground so as to obtain the shortest possible length of travel for the sewage. Another drawback was that the river Aire flows between the city and the part of the site suitable for the works. Hence, it was necessary to arrange for the sewage to be conveyed right across the valley. Those drawbacks, however, were, as we shall show, satisfactorily overcome.

The first works to be undertaken on the new site were those in connection with the disposal of sludge, because it was considered that, by the proper treatment of all the sludge, improvement in the condition of the river Aire could be effected in the shortest possible time. Accordingly, the construction of a press-house was begun in the year 1910, and the house was completed and put into service two years later. When it was in service, it was possible to pump much of the sludge from the Corporation's Frizinghall works to Esholt, so that a greatly reduced quantity found its way into the river by way of the Bradford Beck. The sludge was forced by compressed air for a distance of 4·12 miles through an 8in. diameter main, and that method was continued until the spring of the year 1926, when the new main outfall sewer, which will be described later, came into operation for the conveyance of crude sewage to the new Esholt works.

The main press-house and its accessory buildings cover an area of 1¼ acres and comprise a grease-house, 237ft. by 50ft.; a press-house, 237ft. by 92ft.; an engine-house, 115ft. by 40ft., and a boiler-house, 80ft. by 68ft. There is a basement under the press-house for the accommodation of railway trucks to receive the press-cake from the presses, and there is also a basement, under the whole area of the grease-house, in which there are grease storage tanks, press liquor tanks, grease separating tanks, &c. The buildings are of sandstone with brick internal facings and specially designed reinforced concrete floors. The equipment includes a chimney 8ft. square internally, and 200ft. high, a chemical laboratory, a mess-room, blacksmiths' and joiners' shops, a transformer sub-station, a solvent plant, &c. Aerial photographs of the various buildings on the site are reproduced on page 64.

Main Outfall Sewer in Tunnel.

The work of driving the main outfall sewer in tunnel was begun in 1913. It has already been explained that it was decided to construct the tunnel because, only by taking the shortest route, could full use be made of the lands available at Esholt by gravitation. As it is, there is only a difference in level of 12ft. between the Frizinghall district of the city and the disposal site at the north side of the valley of the Aire, a distance of more than 3 miles. A contract was entered into for driving the tunnel at a cost of £113,971, but after some preliminary work the contractor became bankrupt. Borings had been previously sunk on the line of the tunnel, but the Corporation decided that, before a second contract was entered into, it would sink two shafts on the line to be traversed by administration. That work was completed in 1914. In the same year, just before the outbreak of the war, a further contract was entered into, the amount in that case being £121,616. The contractor, however, was not able to go on for long with the work unhampered by the restrictions in the supply of materials, and the difficulty of retaining his men who were constantly being taken away for

war service. He was glad therefore when, in consequence of Treasury restrictions on borrowing, the Corporation decided to shut down the works in 1916. Nothing further was done until after the war. In 1919, however, the Corporation decided to carry out the work by direct labour, and since that time no contractor has been employed on the works; everything—that is to say, the bulk of the Esholt scheme—has been done by direct labour, the Corporation's engineer acting throughout as administrator.

In the autumn of 1919 bottom headings, about 7ft. square, were started from both the Frizinghall ends, and for the first twelve months nothing else was done. It had been intended to work in both directions from the two shafts above mentioned, but that proposal was abandoned, owing to the high cost of carrying materials up the hills to the tops of the shafts. The bottom headings having been well advanced, the opening out of the tunnel excavation to full dimensions was started in November, 1920. It was decided, for traffic reasons, however, not to concrete the invert, but only the side walls and crown of the arch. For the concrete lining special steel centerings were used, and lengths of 12ft. were dealt with at a time. The centerings were carried on wheels, and there was a row of jacks on each side at the foot,

FIG. 2—DRIVING THE MAIN OUTFALL SEWER IN TUNNEL

so that accurate adjustment was readily possible. Work in the tunnel is illustrated in Fig. 2.

All the junctions of the tunnel—that is to say, those between the two portal headings and the bottoms of the two shafts and between the two shafts—were accurate. The alignment of the tunnel was found to be within the thickness of a candle flame, not only at the centre of the hill, but also when the lines were produced, a full 3 miles from the Esholt transit station. The greatest error in level, after careful instrument work over difficult country across Idle Moor for 3 miles, including transferring the levels down the shafts, and afterwards picking up the points underground at the various junctions, was found to be ½in.

When the whole length of nearly 2¾ miles had been driven and concrete lined as regards side walls and arch, the completion of the oval section, by the construction of the invert, was begun, starting from the centre of the hill and working backwards. At the same time, a complete lining of blue bricks, 4½in. thick, was put inside the concrete.

In boring the tunnel the lower coal measures were passed through. Coal seams and old workings were met with, the latter occasioning a good deal of expense in foundations. The tunnel also traversed ironstone—which was difficult to pierce—and treacherous shales, while many faults were encountered, one of them being more than 100ft. wide, and containing mud and water. Large quantities of water had not to be contended with, however, and the Corporation was fortunate in not tapping the large volumes of water which are known to exist in the old abandoned stone mines on Idle Moor. The excavation was carried out by means of compressed air drills. At first, ponies were used for underground haulage, but they were soon discarded for electric traction. The excavation and lining of the tunnel was let to sub-contractors on a piecework basis, and the rate of progress most satisfactorily increased as the men got used to the work. How considerable the increase was is shown by the following figures, which show the progress in excavation and putting in side walls and arch during the four years, or parts of four years, that the tunnel was under construction:

1920	25ft. per week
1921	74ft. „ „
1922	93ft. „ „
1923	99ft. „ „

These increases occurred, it should be remembered, in spite of the constantly increasing distances of the working faces from the portals, and consequently of the growing difficulty in discharging excavated material and maintaining adequate ventilation.

The work of forming the invert was begun in July, 1923, and finished in the autumn of 1924. During that period, in addition to the concrete work, 2½ million bricks were laid in the 4½in. brick lining. In this department, too, some excellent progress was registered, as many as 860 bricks per man being laid per eight-hour shift in the circular section, including washing down the brickwork.

INTERCEPTING SEWER.

The construction of an intercepting sewer from the Eccleshill and Idle districts was begun in August, 1909, and finished in June, 1910. The total length of this sewer is 3000 yards. Its upper end consists of 24in. stoneware pipes, while for 2092 yards it is egg-shaped, 2ft. 4in. wide and 3ft. 6in. high, with a discharging capacity of 12,000,000 gallons a day, its gradient being 1 in 630. This sewer makes junction with the main tunnel sewer just as the two enter the Esholt estate, that is to say, at the discharge end of the sewer.

DETRITUS AND STORM WATER TANKS.

The tunnel and intercepting sewers discharge, first of all, into a detritus pit, measuring 55ft. by 83ft. 9in. by 11ft. deep, and then into two detritus tanks, measuring 150ft. long by 40ft. wide, and having a combined capacity of 1,000,000 gallons. These tanks have blue brick facings. They are illustrated on page 64. There are, in all, seven storm water tanks, which vary in size, and cover altogether 6 acres, the average depth being 6ft. 6in, and they have a combined capacity of 11½ million gallons. The sludge from the detritus and storm water tanks passes to the press house, which we shall describe later, in sealed mains, under gravity.

The sewage is discharged from the two sewers on to a fan-shaped apron, the object of which is to spread out the waters to the full width of the detritus pit. In the latter are retained stones and the coarser particles of grit as well as lumps of clotted cotton waste, wool and rags of a size likely to cause stoppage in the pipes and interfere with the sludge-treatment processes. The deposited material is dredged out, as required, by a grab crane. From the pit, the sewage passes through a screening plant—which, however, is not in use at present—to the two detritus tanks, which retain the finer mineral matters, whilst floating matters are prevented from going forward by deep scum boards. All the sewage—including the storm water—after leaving the detritus tanks, is passed over two weirs, each 33ft. long, where the flow is recorded by means of Lea recorders, and is then directed to a storm water bay, where the excess water is diverted down a cascade into the storm water tanks. A third recorder measures the volume of storm water as it passes over an elliptical weir 160ft. long. The sewage, which is to undergo full treatment, flows on from the storm water bay to the head of a syphon, which is controlled by penstocks.

It was the original intention to treat fully three times the domestic sewage flow and $1^{1}/_{10}$th times the trade waste flow—which would have been equivalent to treating, fully, 32 million gallons daily, and partially treating 64 million gallons daily, in the storm water tanks. Experience, however, showed that, owing to the high rate of flow during working hours, to which reference was made above, a slight amount of rain caused very strong sewage to flow to the storm water tanks. This storm water was very foul and contained a good deal of grease. Moreover, difficulties were experienced in removing the sludge over so large an area, with such quickness as to prevent aerial nuisance. The amounts of liquid dealt with were therefore reversed, 64 million gallons a day being carried forward to precipitation tanks and the remainder only flowing to the storm tanks, which, consequently, only came into use occasionally.

SYPHONS CROSSING THE AIRE VALLEY.

It has been explained that the main tunnel outfall and intercepting sewers discharge on the south side of the Aire Valley, whereas, the site where the sewage is treated is on the north side of the valley. The original proposal was to convey the liquid across the depression in an overhead aqueduct, but the rise in the cost of materials which took place after the war rendered such a construction too expensive. It was, therefore, decided to employ cast iron syphons, but to introduce several safeguards against blockage because the rate of flow of the sewage through the pipes would, frequently, owing to the restricted head, fall below 2ft. per second. The safeguards adopted were the following:—(1) The provision of a wooden sphere, 3in. less in diameter than the internal diameter of the pipes. The ball is made up of four segments of timber bolted together. Its weight is such that it floats low and just about displaces its own weight of water. It is found that, without any help, except guidance to the particular line of pipes which it is desired to clean, the flow of water draws the ball down a leg through a vertical height of 68ft. at the head of the syphon, after which the ball passes along the pipe line on a slightly ascending gradient with, finally, a sharp gradient at the delivery end. The retardation resulting from the top of the globe rubbing along the intrados of the pipe causes an increase in the velocity of the liquid underneath the ball, and therefore, all the sediment is stirred up and moved forward. The ball travels the distance across the valley of 712 yards in seven minutes. The ball can be seen hanging from the crane in the photograph showing the precipitation tank and sulphuric acid plant, reproduced on page 64. Each pipe line in use is cleaned in this manner once a week, and, although the method has now been in operation for five years, the mains are free from deposit. (2) The syphons were arranged to cross the river on a reinforced concrete bridge of 130ft. span, a photograph of which is reproduced in Fig. 3. This arrangement made it possible to fit wash-out pipes leading to the river, so that, in case of necessity, the pipes can be entirely emptied. (3) Lastly, cast iron access doors—or hatch boxes—were put into each pipe line at various points, so that, if it became desirable, workmen could enter the pipes when they were emptied and dig them clear.

Each of the pipe lines has an internal diameter of 48in. and is 700 yards long, and each is capable of passing 30 million gallons of sewage per day. Ordinarily, two of the lines is in use, while the third is kept as a reserve. The pipes are laid partly in tunnel and partly in cutting. The tunnel was necessary in order to pass under the Leeds and Liverpool Canal, and considerable difficulty was experienced owing to the fact that the roof of the heading was within 4ft. of the bottom of the canal. Special

FIG. 3—SYPHON PIPE LINE, AIRE CROSSING

cast iron segments had to be designed for the work. The pipes cross the river on a reinforced concrete bridge having a span of 130ft.

TREATMENT OF THE SEWAGE.

As has been already said, the best and cheapest way to treat the sewage was found to be to add sulphuric acid to it. The object of the addition is to "crack" the soaps in the liquid, as well as to precipitate a good deal of the dissolved matter, the wool waxes and suspended matter being carried down in the process. Since, as was shown above, the alkalinity of the incoming sewage may vary at different times during the day, it is necessary to observe continuously the analysis of the liquid. For that purpose, samples are taken every quarter of an hour throughout the twenty-four hours, and the addition of the acid is made in accordance with the reactions of those samples, the endeavour being to produce a liquid which shall be about 10 parts per 100,000, and methyl orange being used as the indicator. Formerly, it was not the custom to take these samples, but to add the acid at regular periods throughout the day. That practice was expensive, but it was found that the filtration of an acid sewage had its limits. When the addition of the acid was continuous, as much as 20,000 tons of it was required during the year. By only adding it as required to give the liquid the desired acidity, the necessary quantity has been reduced to from 12,000 to 13,000 tons per annum, a reduction which, of course, represents a considerable saving of money. Now, at certain periods during the night, on Saturday afternoons, Sundays and Monday morning, no acid has to be added. The sulphuric acid plant is illustrated on page 64.

(To be continued.)

THE fact, related in our issue of July 1st, that the considerably accelerated 5.20 p.m. express from Liverpool to Euston will call at Willesden, suggests a great convenience to passengers residing in the western suburbs. Before the use of corridor coaches allowed for travelling ticket examiners, express trains to London called at such stations as Willesden, Kentish Town, Finsbury Park, and Clapham Junction for the collection of tickets. That allowed many passengers to reach their destinations without going forward to the terminus and coming out again on a local train. By alighting at Willesden passengers off the 5.20 p.m. from Liverpool can join the tube trains to Charing Cross, London Bridge, and Morden or the electrically operated trains of the L.M.S. Company to Earls' Court, Richmond, Watford, and Broad-street.

Steel and Empire Trade.

By E. T. GOOD.

THERE are great iron and steel trade chances within the British Empire. It is to be hoped that they may have full consideration at the Ottawa Conference. Here are some of the cardinal points :—

Newfoundland holds enormous deposits of good iron ore, easy to mine and easy to ship, and Britain has to import iron ore, but this country uses foreign and not British Empire ore.

India was calculated to want another 30,000 miles of railway, with the necessary equipment, before the war (an expenditure of about £400,000,000 was forecast). To-day India wants still more railway extensions and furnishing. Britain wants to make and export more steel rails, locomotives, &c.

Canada imports in a normal year about 200,000,000 dollars' worth of iron and steel and products, plus engineering goods—things in which we specialise and desire to export in greater quantities ; but Canada gets nearly all her imports from the United States, a foreign country in which, because of enormous inland transport distances between ore and coal, and between steel works and points of exportation, the costs of production and carriage are very much higher than in little Great Britain, with its very short and cheap hauls for heavy goods.

India, South Africa, Australia, and Canada want to make steel and products for themselves. They have established industries. But in most cases the raw materials are so far apart, and other conditions are such that very little iron or steel, and few, if any, products can be made at an economic, competitive cost, in the Dominions or Colonies, and it would, in nearly every case, pay the Britains beyond the Seas better to import than to make iron, steel, and engineering goods. There are, however, certain primary or intermediate branches of the steel industry which our friends mean to maintain or develop, within limits, and with a clear understanding and fair agreement it might be arranged for the Dominions to take more British and less foreign products of kinds they are obliged to import, and for British manufacturers not to encroach on lines the Dominions can and wish to make for themselves.

If the representatives of the various interests and parts of the Empire will get together and discuss frankly, with the facts in true focus, the matter of developing inter-Imperial business in iron ore, iron and steel, and steel products, on mutual benefit lines, every producer and consumer in the Empire might gain advantages. This Empire holds nearly all the necessary iron ore, manganese ore, tungsten, &c., and all the coking coal necessary for the best and fullest manufacture of steel. Some parts of this Empire want tens of thousands of miles more railways, plus other things made of steel But we must have understanding, co-operation, organisation, if we are to make the most of Empire resources and bring full prosperity to Empire industries. The opportunities are big.

CANADA.

Canada offers great chances. Many ships might be profitably employed taking British coal and steel and products to Canada and bringing back Newfoundland iron ore as return cargoes. Also Canadian wheat and timber. Canada is unable to make much steel for herself at a competitive cost. The steel Canada imports from the United States costs much more per ton, quality for quality, than the price British steel makers can quote, because whilst vast distances separate the ore from the coalfields, and the ironworks from ports or boundary stations, involving enormous railway charges on the raw materials and the finished heavy goods, we have in Britain much the shortest and cheapest hauls from mines to works, and from works to docks, in the world, and our freights from this side to the other side of the Atlantic are nothing near the overland rail charges on heavy goods in the United States. Figures will be given in a moment.

In a normal year Canada imports over 1,000,000 tons of finished iron and steel (1,385,000 tons in 1929, before depression came), and great quantities of implements, tools, utensils, &c., made of steel. It has been customary for Canada to import between 85 and 90 per cent. of the total from America. Never until recent months have British manufacturers been responsible for more than 12 per cent. of Canada's imports. The trade has been left, almost unchallenged, to the Americans. A delusion has been hugged. It has been imagined that because Canada and the United States are next-door neighbours, therefore cost of transport must be much less on American than on British goods. That is absolutely mistaken. However, the Americans having been able to cultivate the Dominion market, it follows that the Canadians have become accustomed to American weights, measures, designs, and specifications and standards, and the ports of Canada have not been equipped to deal with a heavy import trade in British goods ; neither have the ports of Newfoundland been designed to ship a lot of iron ore to Britain. The loss, due to misconception and ignorance, has been serious.

In the case of steel-making materials and steel products, cost of transport is vital. It takes 2 to 3 tons of ore, plus some limestone, and from 2 to 5 tons of fuel to make a ton of iron or steel or highly finished products, and unless cost of transport on these heavy materials or goods is low, no country can make or ship steel at an economical cost. It is on the vital point of transport cost that we hold an enormous advantage over our American competitors ; but, so far, it has not been acknowledged or grasped. Here are the facts :—

A steel-making firm with its plant near Sheffield, almost as far from a port as a British works can be, and a plant, moreover, with no iron ore mine at its back door, figured out its total inland transport costs on a ton of finished steel up to the ship's side for export at only 28s. 9½d. per ton a few years ago, since when our rail rates have been reduced twice. Nowhere in the world overseas is there such a low transport cost as that, for in all the other countries there are long haulage distance for one or more of the raw materials, and in every case there is a long haul for finished goods from works to ports. Here we have ore and coal mines, works and ports, nearly side by side. However, with recent rail rate reductions, the firm alluded to could not prove its total inclusive charges for transport to be even 25s. per ton now. Steel firms with their plants in or near Glasgow, Middlesbrough, and Newport, have transport charges much lower than those in and near Sheffield. Actually the average, all-in transport charges on a ton of finished British steel up to the ship's side is less than 20s. Then, to carry the steel to Canada the freight is only another 20s. per ton. Freights on steel products, even up to £20 per ton value—light and awkward products to stow in ships' holds—have been quoted under 20s. per ton freight, Liverpool to Montreal. Thus it can be said that our combined assemblage charges on the raw materials, the works to port transport, and the shipping freight to Canada, amount to barely £2 per ton of British steel. Contrast this with the American charges.

American steel makers have testified over and over again to the Tariff Board and other authorities that the assemblage costs—the charges on the ore, fuel, lime, &c.—to make 1 ton of steel at the works range from 7 to 10 dollars, and then the cost of carrying the finished steel from works to port or export boundary station, costs from 5 to 12 dollars per ton.

The *Iron Age* experts recently figured it out, after careful investigation, that the average all-in transport cost on a metric ton of steel in the United States was 59s. 2d., compared with only 21s. 3d. in Britain. Since then we have had two rail rate reductions on ore, fuel and steel ; but in the United States they have had two advances. One increase was effected by reclassification of goods rates, and the other has been a recent 10 per cent. all-round advance by Government sanction. Thus, to-day, a ton of American steel has to carry more than three times as much transport as a ton of British steel consigned to Canada. But that is not all. When the American steel arrives at the United States boundary station it has to carry Canadian rail rates to Canadian stations. Before the recent rail rate alterations just mentioned, a ton of Sheffield steel could be carried to Moose Jaw, Calgary, and other places out that way, much more cheaply than steel was carried from Alabama and Pennsylvanian works to those Dominion stations.

Here are some actual through rates before the recent 10 per cent. advance was authorised by the United States Government :—Crude steel, an easily loaded commodity, Pittsburg to Montreal, full truck loads only, 35s. 2d. per ton ; crude steel from Uniontown to Quebec, 43s. 11½d.; on ordinary iron and steel articles unenumerated, Allantown or Bethlehem to Montreal, 80s. 7d.; and to those charges there stood to be added at least 30s. for assemblage of ore and coal to make the steel. So we see that the all-in transport charges on the American steel for leading cities in Eastern Canada ranged from 65s. to more than 110s. per ton, compared with a total of 40s. on British steel to the Dominion cities named. To-day, the difference is greater in favour of British steel, besides which there is a fiscal preference for our goods in Canada. Obviously, British steel can be offered much more cheaply than American steel. Let the business be properly organised—it ought to have been organised and rightly cultivated many years ago. It is only quite recently—since 1929—that there has been a British Steel Export Agency formed to tackle the Dominion market. It has taken several years to convince even a few British manufacturers that British tranport costs are lower than American costs. Now, with American rail rates still higher, with the Canadian tariff more favourable to us, and with the Ottawa Conference opening, now is the time to get down to real business—the organised shipment of Newfoundland iron ore to Britain, and the organised shipment of British coal and steel to Canada, without encroaching on the trade already developed by the steel makers in the Dominion.

Efforts to make steel in Canada have met with little success. During three-quarters of the nineteenth century, the idea was entertained and works were erected and operated from time to time, but losses and not profits were made. Later Government bounties were paid on pig iron and steel, and Protection was granted ; but still Canada failed to render herself independent of imports. As in the United States, long distances separated the ore from the coal, and wages were high. Again, the population of Canada being very few per square mile, the market was not suitable for a high-cost industry with long haulage distances. In the last year before the war Canada managed to make about 1,000,000 tons of crude steel. The output to-day, with a bigger population and more steel needed, is at a rate less than half the 1913 rate. However, there are branches of the steel trade which Canada is determined to cultivate, and those should not be challenged by isolated or individual British firms ; but an understanding should be arrived at under which the Dominion would take more British and less foreign steel and products such as we specialise in, and reciprocal preferences should be granted. The Dominion market is good and growing, and most of the heavy manufactures required must be imported from somewhere. With ready return cargoes of Newfoundland iron ore the outward freights could remain low, and foreign competition could be beaten.

INDIA.

India is a highly promising market for British steel, the current trade depression being no more than a passing phase of commerce. India has a steel industry, but its position and significance seem misunderstood. Before the war India was our biggest overseas customer for iron, steel and engineering goods. So she has been since the war, but foreign competition has been keener, and financial and political conditions have been bad for trade recently. Things will come right in time, and then India will import much more steel than in past record years. The idea that India will make enough steel for herself, and even enter largely into the international competitive markets, is mistaken. The arrival of a cargo of Indian steel bars in Scotland early this year created something like a sensation among our steel makers and workmen and trade unions. It was noted that steel from British Dominions and Colonies was not liable to our new import tariff ; that the Indian steel had thus an advantage over foreign steel in our market ; that Indian steel had Protection in India against British and foreign steel ; and also that the Indian industry had various subsidies and bounties and other favours from the Government of India. But other points did not, and have not, received due attention, and the real facts ought to be known before the Ottawa Conference has its attention called to the "dumping" of Indian steel in Britain.

Indian pig iron is frequently imported into Britain ; it goes into the United States occasionally—the biggest of iron-producing countries—and it is exported in large quantities to Japan to be converted into steel. But the British import of Indian steel bars whilst our steel industry is slack is regarded as serious. There must have been very unusual circumstances to account for this. Probably the bars came for a mere "ballast" freight accepted because no cargo at a paying freight was available, and possibly the bars happened to be at or near an Indian port, held on stock by some merchant hard up for money and with no early prospect of a customer in India. Certain it is that India cannot make cheap steel for her own market, much less for export to a far-distant market. India makes only one grade of pig iron at an economic or competitive cost. The facts had better be understood before the matter of steel trading between various parts of the Empire is raised at Ottawa.

India started making iron and steel on modern lines in 1911. In 1913 the output of crude steel was 66,000 tons. India imported nearly 1,250,000 tons of iron and steel and products, plus engineering goods, in 1913. It was then that India was stated to want another 30,000 miles of railways and more steel for other purposes than she was getting. Great schemes were being planned. But during the war imports were reduced, for American and European works were busy with munitions, prices were high, and freights enormous. Following the war for nearly three years, steel was at famine price. So railway building and other steel-using schemes were not proceeded with according to requirements. When prices did drop and supplies of steel became abundant Indian financial and political troubles caused further delays, and recently a special and expert committee has reported Indian railways very seriously short of trade needs. An enormous construction programme will have to be started soon or transport facilities will be chronically below requirements, and Indians and Indian trades will suffer acutely for many years to come.

However, during the war the development of India's own iron and steel industry was pushed forward In 1918 India made three times as much as in 1913. In 1929 she made her record high production—573,000 tons of crude steel. Nevertheless, in 1928–29–30, and in the absence of any great railway schemes, India imported more steel than in any three years before she made steel for herself. In 1929 the imports exceeded those of 1913 by 250,000 tons, besides which the works in India made 500,000 tons more in 1929 than in 1913. That evidences India's real requirements in steel, and they are further emphasised by the fact that railway constructions have been badly neglected for nearly twenty years.

The potential, or prospective, demands of India for steel and engineering goods are vast.

When the manufacture of steel on modern lines began in India we were told that with cheap coal and labour and great iron ore reserves the country would make the cheapest iron and steel in the world, meet all her own wants, and then develop an export trade at extremely low prices. That prediction has been falsified. When international prices dropped in 1921 it was revealed that India could not make steel cheaply. The Government increased the protective tariffs. It paid bounties and increased bounties. And more recently it has agreed to pay much more than market price for the steel it buys from the Indian firms. Briefly, there has been the following record of developments :—

1916.—Indian import duty on iron and steel and products advanced from 1 to 2½ per cent.
1922.—Tariff increased to 10 per cent.
1927.—Tariff increased on some imports.
1927.—Increased tariffs arranged to give fiscal preference in case of some imports from Britain.
1927.—Bounty of Rs. 12 per ton granted on crude steel made in India by Indian manufacturers or firms.
1927.—Government agreed to pay Rs. 110 per ton more than previous price for steel rails made in India.
1930.—Special inquiry by Tariff Board. Evidence given that steel rails cost more by 30s. per ton to make in India than the price at which they could be imported from Britain ; that tinplates cost 127s. 6d. per ton more to make in India than to import from Britain ; and that the steel framework for a modern railway coach cost £83 more to make in India than to import from Britain.
1930.—Indian Government decided to pay Rs. 130 per ton more for Indian steel rails than the price at which British rails could be imported.

To put it briefly, the cost of assembling raw materials, of mining ore and coal, the cost of labour at the works, and the transport charges of finished goods from the works to various cities or ports or consuming centres, are so high that steel cannot be made in India, or compete against imported steel, without extremely generous Government favours. Native labour is not adaptable for hot and heavy forge and furnace work. Labourers will not remain in the works long enough to become efficient. They soon return to pastoral work ; the climate is not right for steel working ; imported labour is costly ; transport charges are excessive. India will import more than ever before as soon as financial and political troubles are half smoothed out. Let British steel makers and engineers lay their plans accordingly.

The Royal Agricultural Society's Show.

No. III. (*Conclusion*).*

THE Royal Agricultural Society's Show at Southampton concluded on Saturday last. The weather, which was not favourable on the opening day, improved and the conditions generally left little to be desired ; but the records of the turnstiles demonstrate a lack of interest on the part of the public in the South of England for this form of entertainment and instruction.

TECALEMIT, LTD.

Much more attention is now being paid by users of agricultural machinery to the provision of adequate lubrication of the working parts than was customary only a few years ago, when the common oilcan was considered sufficient. There are few modern appliances used by farmers that are not fitted with some form of pressure lubrication, and the Tecalemit system is very extensively adopted throughout the products of the firms which exhibited at Southampton. Tecalemit, Ltd., Brentford, Middlesex, had an interesting display of its multifarious appliances for almost every conceivable purpose. One special appliance was the Brentford mechanical lubricator, for use in conjunction with the company's central lubrication system.

A feature of importance in this lubricator, which is illustrated in Fig. 18, is the absence of intricate gearing and operating mechanism. The pump consists of a number of independent pistons actuated through rocking arms by excentrics running in oil, and working in cylinders formed in the oil container. The standard models are designed to give a pressure of 3000 lb. per square inch, and the stroke of each piston can be adjusted while running, so as to vary the output between the maximum of 0·1 c.c. per stroke and zero. To adjust the effective stroke of any piston, the knurled knob at the top of the pump is rotated, which movement alters the position of the transmission block on the piston-rod. The oil flows from the container through a lateral hole into the cylinder and is forced out through a non-return valve and connections, through the pipe line to the bearings. It will be noted that the feed channel is placed above the bottom of the container ; this space provides an oil bath for the excentrics in the event of the pump being allowed to run dry. The maximum number of piston strokes recommended for continuous running is 250 per minute, corresponding to 250 r.p.m. of the driving spindle. At this speed each piston is capable of giving an output of 25 c.c., *i.e.*, 425 drops per minute, or one-third of a gallon per hour. At the same speed, by turning the adjustment knob, the output can be reduced to one drop per minute or zero as required. An important feature of the pump is the filtering arrangement provided between the container and the pumping chamber. A phosphor bronze gauze of 100 mesh is fitted and is sealed in the joint washer between the container and the pumping chamber. No foreign matter can, therefore, reach the working parts or pumping units, or pass through the pump to the conduits and bearings. A drain plug is provided in the container below the gauge glass.

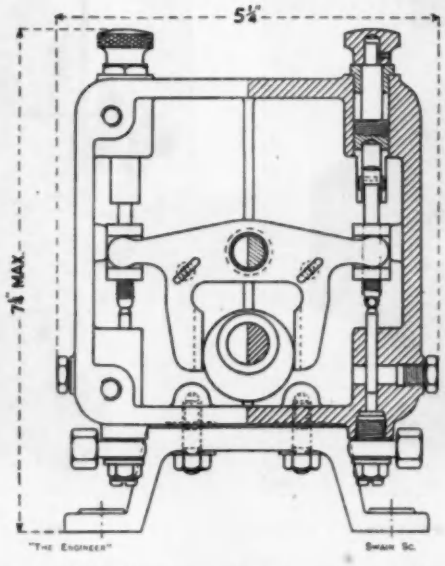


FIG. 18—MECHANICAL LUBRICATOR—TECALEMIT

FODENS, LTD.

This Sandbach firm had on exhibition three oil-engined lorries, two four-wheelers to carry 6–7 tons on four wheels, and one 12-ton machine with six wheels designed for a road speed of 20 miles per hour. All three vehicles are propelled by Gardner full Diesel engines, which have six cylinders and develop 97 B.H.P. at 1550 r.p.m. They start from cold on crude oil. The engine crank shaft has seven bearings, and a submerged pump provides forced lubrication to all the working parts. The lubricating oil has to pass through two filters, one of the Auto-Clean type in the circulation system, and a submerged filter in the sump. The engines have overhead valves in detachable heads, and the atomisers can be removed without breaking any water joints. Governing of the engine is effected by means of a powerful centrifugal governor which controls the fuel pump automatically.

The rear bogie of the 12-ton lorry consists of two axle casings mounted on springs attached to the main frame of the vehicle, and the drive from the gear-box is effected through a propeller shaft with a universal joint at each end to a worm transmitting motion to a bronze worm wheel and differential gear, which, in turn, drives the floating axle in the leading axle casing. The propeller shaft is then continued and drives the trailing axle in a similar manner, allowance being made for the rise and fall of the axles on uneven ground. The whole of the worm and differential gears run in oil in an oil-tight casing. A gear-box of the dual type gives eight forward speeds and two reverse speeds. The clutch is of the single-plate pattern, and is totally enclosed. Braking of the six wheels is achieved by servo-assisted foot brakes, and a hand brake is fitted to operate on the rear bogie wheels only. The body is 22ft. long, 6ft. 9in. wide, and 1ft. 6in. deep ; the wheel base 13ft. 6in. to the first rear axle, and the bogie centres are 4ft. apart. The overall length of the vehicle is 27ft. 8in., and width 7ft. 3in. The steering mechanism is a worm and sector. Forty gallons of fuel oil are carried in the supply tank, and a further 12 gallons in a service tank into the latter of which the fuel can be delivered by a hand-operated pump. A view of the six-wheeled wagon is given in Fig. 19.

FIG. 19—12-TON OIL-ENGINED LORRY—FODENS

MERRYWEATHER AND SONS.

The protection of the numerous stands and valuable exhibits of livestock from the risk of fire is a matter of great importance at such events as these Shows, and, as usual, the Royal Agricultural Society entrusted the task to Merryweather and Sons, Ltd., Greenwich, who exhibited several of their latest productions, including a large motor fire-engine, such as is used by many of the largest fire stations in the Kingdom, a Hatfield trailer fire-engine and a trailer pump of the turbine type, which can be readily detached from its two-wheeled carriage and used for general pumping work, as well as for fire protection. The fire station was staffed by Merryweather's own brigade, which, fortunately, was not called upon to deal with any outbreaks of fire.

WALLIS AND STEEVENS, LTD.

This was the first occasion on which Wallis and Steevens, Ltd., Basingstoke, showed an oil-engined roller fitted with the Lister three-cylindered, high-speed, four-cycle, solid-injection engine. The engine has cylinders 4¼in. bore by 5½in. stroke, and gives 30 brake horse-power at 1050 revolutions per minute. The roller has four road speeds of ¾, 1½, 2½, and 4 miles per hour, with a reverse on all four gears. Spur and bevel gears are employed throughout the transmission system, and there is a four-pinioned differential gear with an automatic locking device. The final drive is through spur gears direct to the rear rolls, and the rear axle has an automatic cambering arrangement. The fore carriage is of the under-slung type, allowing the front rolls to adapt themselves freely to the contour of the ground without transmitting rocking motion to the chassis, and so producing a steady rolling effect. The steerage control is by hand wheel, operating the steering pivot on the roller fork through overhead reducing gear, worm, and segment. The steering pivot is mounted in large renewable bushes, which eliminate back lash between the steerage pivot and frame. All the operating gears are machine cut, and ball thrust races are fitted to the worm shaft. The bevel and worm gears are enclosed in grease-retaining covers. This design of roller is made in three weights, namely, 7½ tons, 9¾ tons, and 10¾ tons ; the wheel base is 10ft., and the turning circle 15ft.

PETTERS, LTD.

A very wide range of engines suitable for agricultural, industrial, and marine purposes was exhibited by Petters, Ltd., Yeovil. Most of these engines are familiar to our readers, but we noticed a small air-cooled petrol engine which appeared to be new. These engines are made in two sizes, twin-cylinder 4 B.H.P. and single-cylinder 2 B.H.P. They are of the four-stroke magneto ignition type, and are claimed to be especially suitable for contractor's work where the engines are exposed to all varieties of weather. The drive can be taken from either side of the engine, the shaft on the fly-wheel side being suitable for direct coupling and running at 1500 revolutions per minute, while the other end is fitted with a pulley, and is an extension of the cam shaft running at 750 revolutions per minute. The engine is very compact, entirely self-contained, and can easily be carried by two men. In Fig. 20 we illustrate one of these engines of 2 B.H.P., with an enclosed switchboard for battery charging purposes, mounted on the electric generator. This is a very compact unit. The largest engine on Petters' stand was a 40 B.H.P. "Atomic" Diesel engine, which is built in sizes from

* No. II. appeared July 8th.

7 to 400 B.H.P. Two marine engines were on view, one a 24 B.H.P. "Atomic" twin-cylinder engine and the other a 6 B.H.P. surface ignition single-cylinder engine. It is claimed that the relatively low speed at which these engines operate enables a propeller of large diameter and blade area to be fitted, giving a high efficiency and great pulling power.

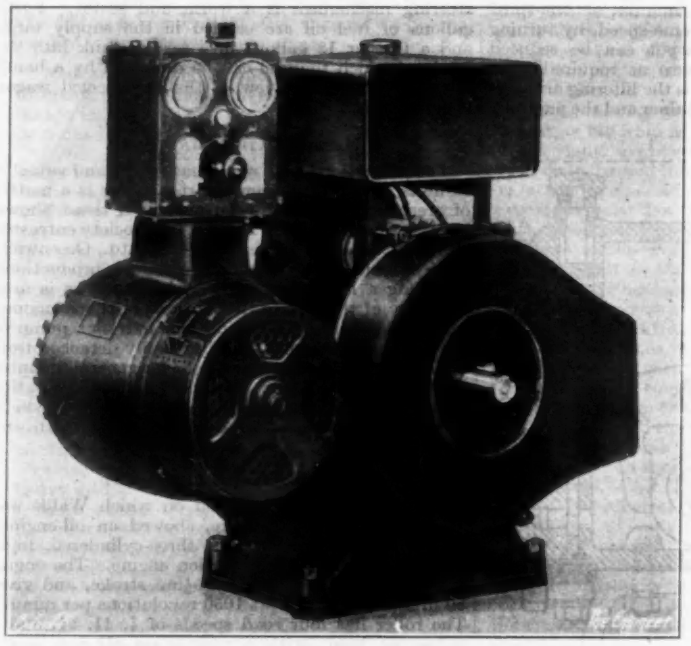


FIG. 20—2 B.H.P. PETROL-ELECTRIC SET—PETTERS

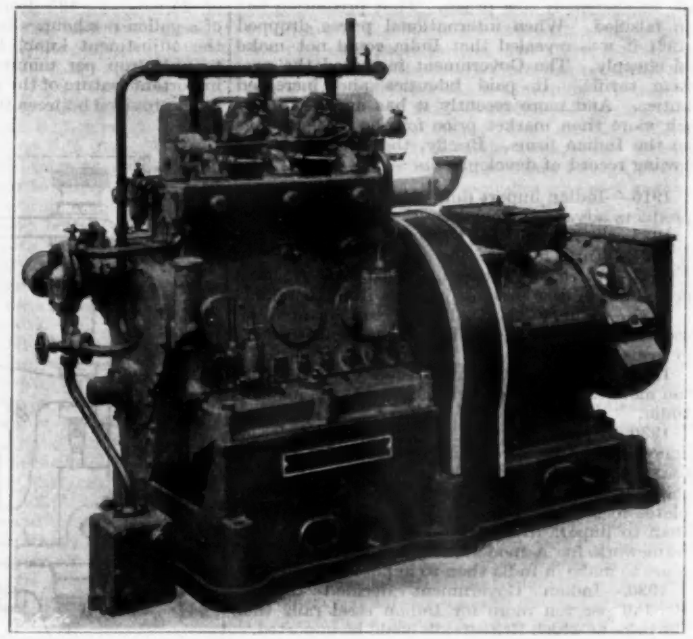


FIG. 21—25-kW OIL-ELECTRIC SET—MCLAREN

FORD MOTOR COMPANY.

Ford motor vehicles for agricultural and industrial purposes, as well as for passenger carrying were exhibited. Those for agricultural work were shown with various attachments, such as cultivator, winch, plough, mowing machine, and belt drive for binders. The agricultural tractor, shown in Fig. 22, has a governor, fitted with a control mounted on the dash, an improved clutch for facilitating gear changing, and a completely enclosed high-tension magneto with an impulse starter coupling. The engine has four cylinders, 4½in. diameter by 5in. stroke, and the crank shaft has three main bearings. Lubrication is on the splash system, the circulation being maintained by oil thrown off the fly-wheel by centrifugal action. Cooling is by thermo-syphon and pump. The large water jackets and radiator tank ensure the continuous flow of water and efficient cooling, which are especially needed for agricultural operations, such as ploughing. Another necessary feature is the float type of air washer, which intercepts all dust in the air used for combustion before it reaches the internal parts of the engine. The transmission mechanism embraces a multiple disc clutch, three speeds forward and reverse, and a semi-floating rear axle on roller bearings with a four-pinion differential. The front axle is drop forged and heat treated, and is attached in the centre directly to the front of the engine, which provides a three-point system of suspension to the tractor. The front wheels are of cast iron mounted on roller bearings, and the rear wheels have spokes cast in the hubs and riveted to the rim. The weight of the tractor is about 3000 lb., the wheel base is 5ft. 3in., the overall length 8ft. 6in., ground clearance 11½in., and the turning circle 21ft. The maximum draw bar pull is 3202 lb.

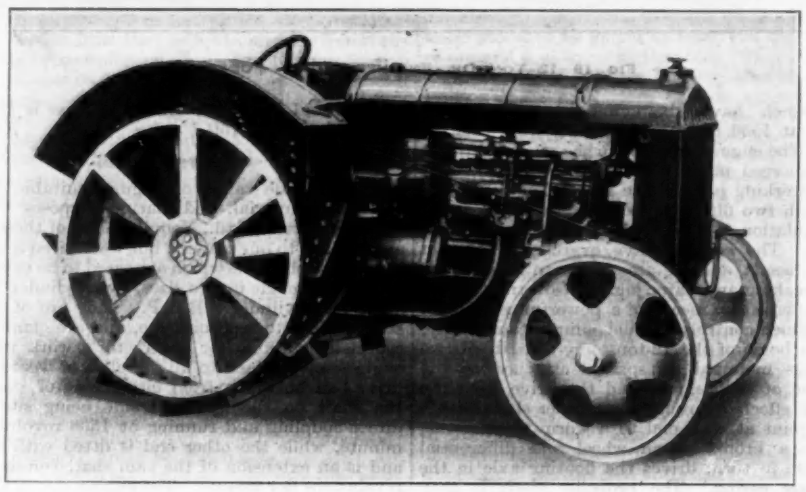


FIG. 22—AGRICULTURAL TRACTOR—FORD

PULSOMETER ENGINEERING COMPANY.

This company showed two of its latest direct-expansion milk-cooling plants in operation, one driven by a 1½ B.H.P. electric motor for cooling only, and the other arranged as a milk cooler and cold store of about 250 cubic feet capacity. In the second case motive power was supplied by a petrol engine. In both instances the cooling capacity is 40 gallons of milk per hour from 90 deg. to 40 deg. Fah.

A 1in. "Centrivac" pump—Fig. 23—driven by a 1 horse-power electric motor, running at 1450 revolutions per minute, demonstrated a neat arrangement for private water supplies. This pump delivers 450 gallons of water per hour against a head of 100ft. and has a suction lift of 25ft. The "Centrivac" pump consists of a rotor set excentrically in the casing, and having two vanes, each carried in slots diametrically across the rotor. The two vanes are definitely located on a centre block, which rotates on a hardened steel pin fixed concentrically in the cover. The vanes rotate concentrically within the casing and are held by the centre pin definitely clear of the casing, thereby eliminating friction and wear. The rotor is also supported clear of the casing. It is claimed that no lubrication is required, the pump being arranged internally with a by-pass to the bearing. Another exhibit by this firm was a trailer fire pump, operated by a Ford engine. This unit is especially designed for farm and estate purposes.

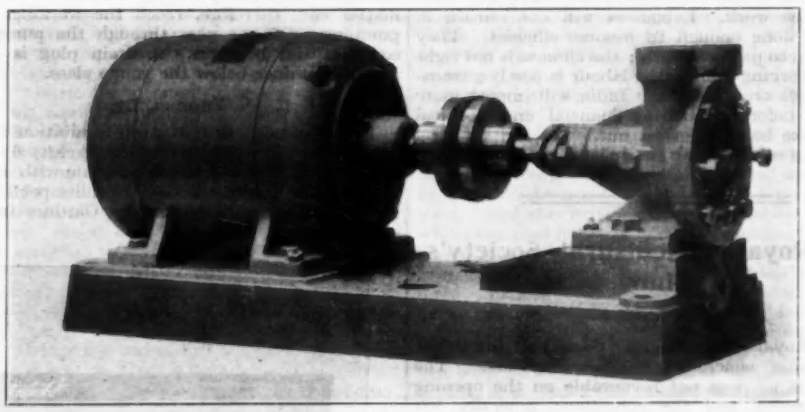


FIG. 23—ELECTRICALLY-DRIVEN "CENTRIVAC" PUMP—PULSOMETER

J. AND H. MCLAREN, LTD.

Messrs. McLaren's exhibits included an oil-engined windlass—one of a pair for ploughing on the double engine cable system—a range of high-speed oil engines, and agricultural implements, such as cultivators and ploughs for cable operation. The windlass referred to is fitted with a McLaren-Benz four-cylinder engine and a vertical winding drum, with coiling gear and 450 yards of steel rope. The three-cylinder compression-ignition engine shown in Fig. 21 is direct-coupled to a 25 kW alternator, and the running speed is 750 revolutions per minute. This engine, during recent tests, has run on the test-bed from full load to no load, and *vice versâ*, without holding down bolts. The bore of the cylinders is 135 mm. and stroke 200 mm. Another attractive exhibit was a 40 H.P., four-cylinder marine engine, with Parsons' reversing gear and hand starting. The speed of this engine is 1250 revolutions per minute.

AEROLIFT PUMP COMPANY.

The method of lifting liquids by the use of compressed air is already familiar to our readers. The chief drawback to this method of pumping for country house and estate purposes lies in the mechanism involved. The Aerolift Pump Company, Helston, South Cornwall, claims to have overcome this objection by the use of a wind-driven air compressor by which the air is conveyed to a chamber in the well, which, without the use of valves or taps, alternately

fills with water and discharges, the water being forced up the rising main to any desired height by the compressed air, and stored in a tank. The apparatus briefly consists of a closed water chamber placed in the well at the required depth with a water inlet valve at the bottom, while at the top is a compressed air inlet, a float valve, a rising main, and an exhaust pipe. The chamber being full of water, compressed air is admitted to it, *viâ* the float valve, and drives the water up the rising main until the bottom of the main becomes uncovered. The compressed air then rushes up the main and reduces the pressure in the chamber sufficiently to deprive the float valve of its support. That valve falling, opens the chamber to the atmosphere, and the surrounding water immediately enters *viâ* the inlet valve, and the process is repeated.

BAMFORDS.

The engine which has gained the Silver Medal this year for Messrs. Bamfords is a 6 B.H.P. model of the vertical compression-ignition type, embodying some new features with the object of promoting efficiency, smooth running, easy starting from cold, accessibility, and ease of maintenance. Reference to the sectional drawing—Fig. 26—shows that the combustion head has side walls of convex shape, and that the air is injected at high pressure in two streams. The fuel stream is injected in the low-pressure zone between the two air streams, thus securing an intimate mixing of the fuel and air, and ensuring, it is claimed, perfect combustion at all loads with the practical elimination of knocking. The atomiser is of the self-cleaning pintle type. The valves are disposed horizontally and can be removed without lifting the cylinder head or breaking the water or cylinder gasket joints. The patented valve operating gear permits the operation of the horizontal inlet and exhaust valves from a single operating rod actuated by an excentric; cams are dispensed with and the working parts reduced by half.

Accessibility, which is a feature of all this firm's engines, is secured in this model by the fitting of a hinge over the crank case, which enables the whole of the working parts to be readily inspected and the piston withdrawn through the crank case for any necessary adjustments and renewals. This is the first engine of this class to embody this construction.

Lubrication is on the splash system, and is provided by a constantly maintained oil level in the sump of the crank case, the usual pump feed being replaced by a gear wheel, which meshes with a pinion on the crank shaft. The engine operates on any of the light Diesel oils, the consumption being about 0·45 lb. per B.H.P. per hour.

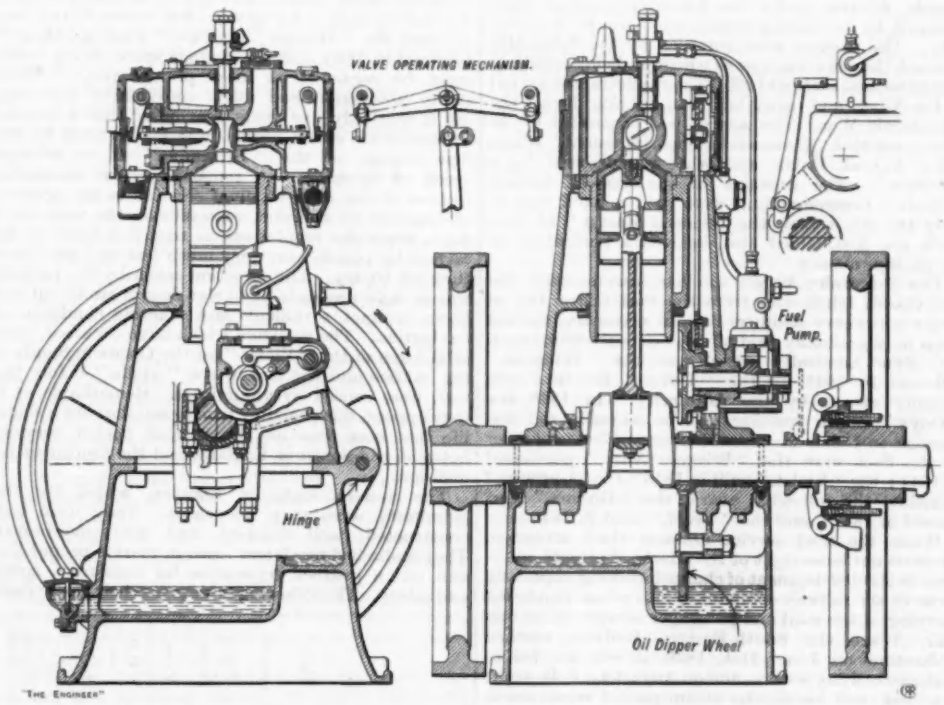
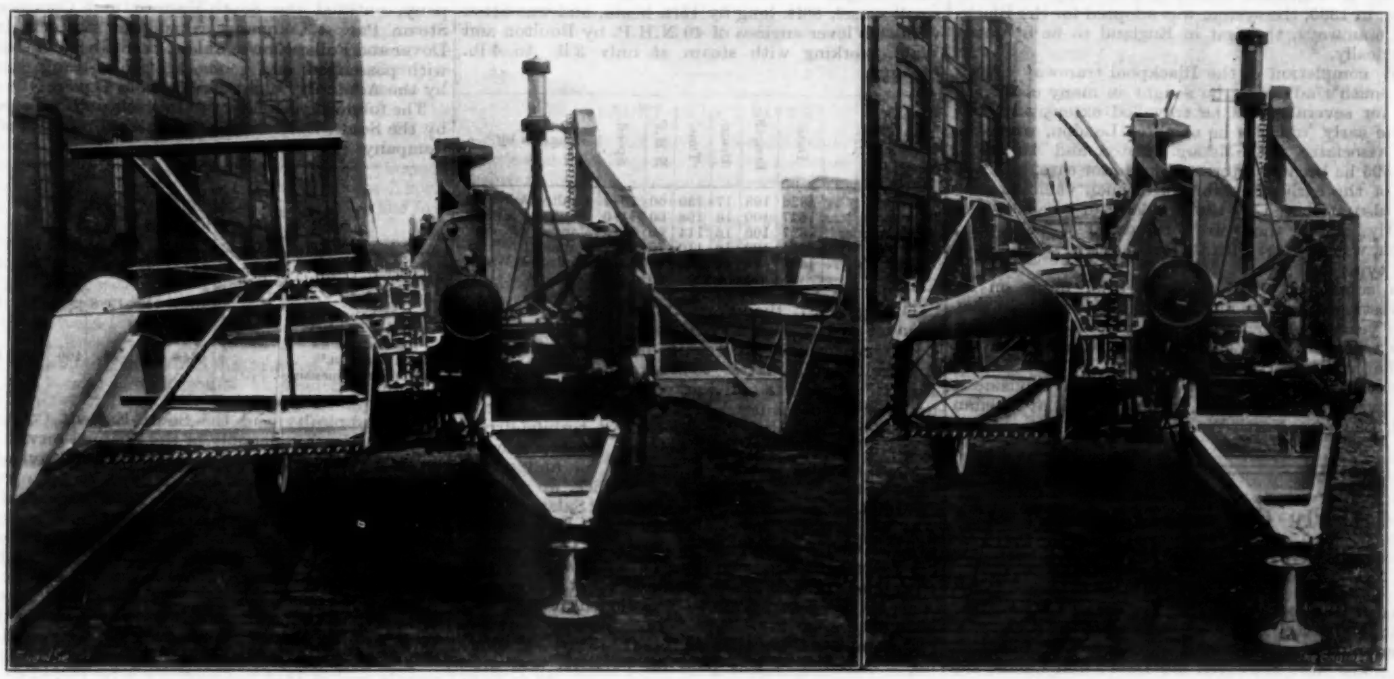


FIG. 26—6 B.H.P. COMPRESSION IGNITION ENGINE—BAMFORDS

INTERNATIONAL HARVESTER COMPANY.

With the object of providing a machine suitable for British farmers, the International Harvester Company of Great Britain, Ltd., 259, City-road, London, E.C. 1, has introduced the harvester thrasher shown in Figs. 24 and 25, equipped with a bagging type platform, a 5ft. cutting platform, and a torpedo-shaped divider. This machine is provided with an auxiliary petrol engine when it is desired to haul the machine by means of a tractor that is not fitted with a suitable power "take off." For the purpose of transport the bagging platform can be folded, or it may be easily removed by taking out a few bolts. Another feature of the machine is the lifting jack seen under the front end of the frame. This jack is hinged to the frame, and can be swung up out of the way when not in use. The grain tank has a capacity of 15 bushels, and when it is full the machine is stopped and the grain is emptied into bags. As fast as the grain is cut it falls upon a canvas platform and is delivered to a carrier which acts as an automatic feeder carrying the grain to the thrashing cylinder. The platform canvas is continuous up to the point at which the grain is delivered into the carrier, but the elevation of the grain from the platform is made positive by a short upper canvas. The carrier consists of two steel chains to which wood slats are riveted. By means of this carrier the grain is fed to the cylinder, being further assisted in passing to the cylinder by two beaters, which also help to maintain an even flow and a uniform speed of the cylinder. Under average conditions the makers claim that not more than two men are required to operate this harvester thrasher, while, when the machine is equipped with a grain tank and operated by the power "take off" from a tractor, one man can operate the whole. When the machine is hauled by horses, the operator's platform is not provided, but instead there is a seat in the front from which the driver can handle his team and control the machine.



FIGS. 24 AND 25—HARVESTER THRASHER, READY FOR WORK AND FOLDED—INTERNATIONAL

MILKING MACHINERY.

There was as usual an extensive display of dairy plant and milking machinery, the makers of which included the Alfa-Laval Company, Ltd., Grosvenor-road, London, S.W. 1; Gascoynes, Ltd., Reading; Vaccar, Ltd., Christchurch, Hants; J. and R. Wallace, Castle Douglas; International Harvester Company, Ltd., City-road, London, E.C. 1; and the Hosier Open-Air Pure Milker, Ltd., Marlborough. Some idea of the developments which have been made in this direction may be gathered from the claim of the Alfa-Laval Company that it has supplied over 174,000 machines, which are capable of milking over 2,000,000 cows twice and thrice a day.

OBITUARY.

MR. MICHAEL HOLROYD SMITH.

IN our last issue we briefly recorded the death of Mr. Holroyd Smith on July 6th. He was an old man, for he was born some eighty-four years ago, and the memory of the pioneer work he did in electrical and motor car engineering is cherished chiefly by those who, themselves, are no longer young, but even within fairly recent years his was a familiar figure at technical meetings on subjects in which he was interested.

He was born in Halifax, Yorkshire, in 1847, and after passing through King Edward's Grammar School, Birmingham, was apprenticed to Francis Berry and Sons, of Sowerby Bridge. Thereafter, he worked for a time with his father and brother, wire manufacturers of Halifax. About this period he became associated with Mr. Louis John Crossley, in

whose grounds in Halifax he carried out experiments on electric traction. They proved so promising that a 4ft. 8½in. track, 110 yards long, was laid in a field near the works of Smith, Baker and Co., of Manchester, and a full-size, four-wheeled tramcar was fitted with a Siemens motor, which drove by belt and a differential gear. The electric conductor was in a conduit, and the return was by the rails. The experiments showed that the differential was unnecessary, and led to a modification of the conductor, but the arrangement remained essentially the same, when, in 1885, the system was adopted for the Blackpool tramways, the first in England to be operated electrically.

The completion of the Blackpool tramway caused Mr. Smith's advice to be sought in many countries, and for several years he travelled extensively, but in the early 'nineties he came to London, where he was associated with Messrs. Easton and Anderson. In 1895 he became interested in motor cars, and was one of the earliest exhibitors of such vehicles. He was also attracted by the problems of aviation, and shortly before the war constructed a helicopter, which, we fear, met with the usual fate of machines of that type.

In conclusion of these very brief notes on an interesting career, we must not forget to mention that forty years ago, when technical schools for mechanics were rare, Mr. Holroyd Smith opened classes in the Mechanics' Hall, Halifax.

Some years ago he retired from active business, and lived quietly, as good anglers should, at Maenan Hall, Llanwrst, North Wales.

Early Channel Steamers.

By GERALD AYLMER.

1816 to 1837.

WHEN the long war with France was terminated in 1815 by the Battle of Waterloo, cross-Channel communication with that country was renewed. The mails were conveyed *vid* Dover and Calais, the service being conducted by the Admiralty by means of small sailing vessels.

The period known as the 'twenties and 'thirties of the nineteenth century, when the country had become thoroughly tired of war and gladly turned its attention to industry and science, can be regarded as one of the most interesting in maritime progress. It witnessed the first struggles made by steam propulsion to be recognised as the future motive power for vessels, and the early proving grounds were those narrow strips of water separating England from Ireland and from the mainland of Europe. The first steam passage between Dover and Calais was made as early as 1816, when the Margate steamer "Majestic" crossed between those ports with as many as 200 courageous passengers, a feat regarded at the time as most remarkable. This voyage was, however, only an isolated effort, and it was not until 1820 that a steamer began to run regularly on the route. This vessel was the famous little "Rob Roy," which was first employed in 1818 by Mr. Napier between Belfast and Greenock, and two years later transferred to the Dover station. She was built of wood by the since renowned firm of Denny and Co., of Dumbarton, her dimensions being 81ft. long by 15ft. 8in. beam with a depth of 8ft. Her tonnage was 90, and she was fitted with engines of 30 N.H.P., designed and constructed by Mr. Napier himself. The French Government bought her in 1823 and re-named her the "Henri IV.," and employed her in carrying the French mails between Dover and Calais, on which service it shortly afterwards added another vessel, the "Duc d'Orleans," and subsequently three more, the "Courier," "Poste" and "Estafette."

It is recorded that the Admiralty in 1821 experimented with a steamer for the mail service on this route, but if so we are unable to discover any particulars of her. It can be well understood that the introduction of steam propulsion conferred many advantages on cross-Channel working. Not only did it enable the journey to be made in quicker time, thereby reducing the discomforts of a rough crossing, but the hours of arrival and departure became more regular, and long delays caused by adverse wind, or want of wind, were things of the past.

During 1821 the oversea carriage of the mails was transferred from the Admiralty to the control of the Post Office. Of the vessels with which that Department began its service there is no trace. Most probably it took over those of its predecessors. It was, however, during its period of control that the first steam packet service was instituted between Dover and Calais. Although the vessels, from their size and speed, may perhaps appear to-day as almost contemptible, yet in their time they were famous and were well-known to travellers for many years. This little pioneer fleet consisted of five paddle steamers, particulars of which are given below.

By arrangement with the Belgian Government these vessels also carried the mails to Ostend. Under favourable conditions the time occupied in crossing the 21 miles between Dover and Calais was from 2¼ hours to 2½ hours, and it was recorded as a great feat that on February 5th, 1834, the "Arrow" made the passage from Dover to Ostend in 5 hours 40 minutes.

During 1822 two steamers, the "Sovereign" and "Monarch," began running between Dover and the Continent under private ownership, that of Messrs. John and William Hayward, of Dover. They were of about 100 tons and were fitted with side lever engines of 32 N.H.P. by Maudslay. Another vessel which is recorded as plying on this route about that time is the "Spitfire," built in 1823, but to whom she belonged we are unable to discover. She was a small vessel, 88ft. long by 15ft. beam, and was fitted with side lever engines of 40 N.H.P. by Boulton and Watt, working with steam at only 3 lb. to 4 lb. pressure.

	Date.	Length.	Beam.	Tons.	N.H.P.	Speed.	Engines by
"Arrow" ..	1826	108	17	130	60	10·4	Boulton & Watt
"Crusader" ..	1827	100	16	108	60	11·0	Maudslay & Sons
"Salamander"	1827	100	16	114	60	11·0	Maudslay & Sons
"Ferret" ..	1831	100	16	110	70	11·4	Maudslay & Sons
"Firefly" ..	1831	96	16	100	50	10·0	Boulton & Watt

During 1837 the Post Office discontinued the conduct of the mail service between Dover and the Continent, which was again handed over to the Admiralty. The latter took over the fleet of five Post Office packets and worked them for some years under different names. What eventually became of these forerunners of the magnificent turbine-driven fleet of to-day correctly belongs to a somewhat later date, but as they were built for and served most of their time under the Post Office, we give the information here. The "Beaver" (ex "Salamander") was paid off from the packet service in 1845, and no further trace of her can be found. The "Ariel" (ex "Arrow") was paid off in 1846 and sold between 1848 and 1850. The "Swallow" (ex "Ferret") was paid off in 1846 and recommissioned the following year as tender to H.M.S. "Madagascar," and was broken up between 1848 and 1851. The "Charon" (ex "Crusader") was paid off in 1847, and after being employed as a steam tender, was sold in 1849. The "Myrtle" (ex "Firefly"), on being paid off in 1847, was laid up at Woolwich until commissioned in 1857 as guardship at Sheerness. She acted in that capacity only for three years, and after being employed as a tug at Portsmouth, her name disappears from the Navy List in 1868.

1837 to 1854.

As mentioned above, the conduct of the mail service was in 1837 transferred to the Admiralty. That it could more efficiently and economically undertake the work is obvious, for under the Post Office a complete marine department would have to be maintained solely for the management of a few vessels, whereas under the Admiralty only a slight addition to its existing organisation would be necessary. The packets were regarded by the Admiralty in much the same manner as warships, being regularly commissioned and paid off. Their officers had served in the Navy, and many had seen fighting during the Napoleonic War. The service was controlled by an officer, entitled "Commander Superintendent," whose office was at Dover and who was assisted by a "Purser." The captains of the vessels, termed "Masters Commanding," were paid a fixed sum of £149 18s. 2d. a year, the "Second Master" £71 5s., while the first-named also received a percentage of the passage money.

The Admiralty began the new service with the five vessels taken over from the Post Office, but as larger and faster steamers became necessary, the old ships were gradually paid off as previously mentioned. The first Admiralty vessel was the "Widgeon," followed in 1841 by the "Dover," the first iron steamer owned by the Admiralty. In 1846 the "Onyx" began running and occasionally did the passage to Calais in under 2 hours. The remainder of the fleet were the "Princess Alice," purchased in 1844; the "Violet," built in 1845; the "Garland," launched the following year; the "Ondine," purchased in 1847; and the "Vivid," built in 1848.

While the mail service attracts chief attention, we must not loose sight of the efforts of private enterprise in the development of channel working, especially those of the railway companies, into whose hands the carrying of the mail and passenger service ultimately fell. When the South-Eastern Railway reached Folkestone on June 21st, 1836, it was decided to inaugurate a day service, and on August 1st Folkestone was first used for regular steam packet communication with the Continent. In honour of this event the Mayor of Folkestone and the directors of the railway company gave a banquet. At 12.30 p.m. the "City of Boulogne," with the Union Jack and the Tricolour flying at her masthead, steamed into the harbour and fired a salute. She had left Boulogne at 9.30 a.m. with numerous French officials on board. About the same time as her arrival, the "William Wallace" left Dover for Boulogne with 74 passengers and later in the day the "Emerald" arrived from France with 142 passengers.

These vessels belonged, it is believed, to the New Commercial Steam Packet Company, with whom arrangements had been made by the railway company for the oversea carriage of passengers and goods. The employment of steamers not actually belonging to the railway company proved, however, so inconvenient that the South-Eastern Railway decided that on the completion of its line to Dover that it would run vessels of its own. However, when that town was reached in 1844, it was found that a railway company was not entitled to own and work ships. This difficulty—since removed by Act of Parliament—was overcome by a company being formed by the directors and others interested in the railway company, entitled the South-Eastern and Continental Steam Packet Company, which ran steamers from Dover and Folkestone to Calais, Boulogne, and Ostend with passengers and goods, the mails being carried by the Admiralty night service from Dover.

The following is a list of the vessels put into service by the South-Eastern and Continental Steam Packet Company :—

	Date.	Length.	Beam.	Tons.	N.H.P.	Speed.
"Princess Mary"	1844	143	20·6	294	100	11·0
"Queen of the Belgians"	1845	140	19·8	294	120	11·2
"Queen of the French" ..						
"Prince Ernest"						
"Princess Maud"						
"Princess Helena" ..	1846	160	24	460	160	12
"Lord Warden"						
"Princess Clementine" ..						

The Admiralty and the South-Eastern Company did not enjoy a monopoly of the Channel service, for on May 11th, 1844, the General Steam Navigation Company placed the "Magician" on the route between Dover and Boulogne. This vessel, built in 1842, was 146ft. long by 20ft. beam, with a depth of 10ft. under deck. She was of 175 tons register, and was fitted with side lever engines of 110 N.H.P. The same company shortly added to the service the "City of London," an old vessel, built in 1824, of 235 tons and 40 N.H.P., and it continued to run these vessels up to 1850. The Dover firm of J. and W. Hayward, already mentioned, continued to run its vessels, and in 1843 had built for it by Ditchling and Mare a very fine steamer, the "Princess Alice," and about the same time another Dover firm commissioned Miller and Ravenhill to build a steamer for it on condition that she would prove faster than any other vessel of her class. A trial was arranged between this steamer, the "Ondine," and the "Princess Maud," one of the South-Eastern and Continental Steam Packet Company's vessels, the latter winning by one minute, the speed throughout the race averaging 12¼ to 12½ knots. As both these vessels were eventually purchased by the Admiralty for the mail service, we give particulars of them in the list below of Admiralty packets.

From the earliest days to the present time, the steamers on the Channel service have always possessed a great reputation for speed. For instance, the race between the "Ondine" and the "Princess Maud" occurred in 1845, and the average speed of 12½ knots must be regarded as most praiseworthy. While steam navigation had made considerable progress, yet it was only five years previously that a regular Transatlantic steam service was inaugurated by the first voyage of the "Britannia," at an average speed of 8½ knots. A remarkable and creditable feature of the cross-Channel services is the absence of disasters by collision, especially in the very early days, when the regulations as regarded lights to be carried by vessels were very much less stringent than they are to-day. The direction taken by the packets was at right angles to the great flow of traffic up and down channel, a difficult and exacting condition of navigation. The disasters which have occurred, such as the loss of the "Violet" on the Goodwin Sands in the 'sixties and the loss of the "Stella" before the war, were caused by groundings. Remarkable as it may appear, it is probably true to say that not a single life has been lost on the various packet services between the South of England and the Continent by collision.

The vessels, eight in number, added by the Admiralty were very fine ships. They were well constructed, well manned, and well maintained. They embodied the latest ideas in marine propulsion, and had a justified reputation for regularity, speed and safety. The following table gives their particulars:

	Date.	Length.	Beam.	Depth.	Tons.	N.H.P.	Speed.	Cyls. dia. and stroke.
"Widgeon" ..	1837	108	18	11	164	80	10·3	—
"Dover"	1840	113	21	10	224	90	10·5	—
"Princess Alice"	1843	144	20	11	270	120	12·5	43 by 42
"Ondine"	1844	140	19	11	260	110	12·5	42 by 36
"Onyx"	1845	139	21	11	297	120	12	44 by 48
"Violet"	1845	139	21	10	280	120	12·5	43 by 48
"Garland" ..	1846	141	21	11	303	120	12·75	44 by 48
"Vivid"	1848	150	22	11	352	160	13·5	49½ by 48

The year 1851 was an eventful one in cross-Channel working, as during it the Great International Exhibition was held in London, and the passenger traffic not only exceeded all previous records, but remained the highest for many years. During the same year

the Admiralty Pier at Dover was completed and opened for traffic, the "Onyx" on January 5th, being the first vessel to land passengers on it. In that year also the first submarine cable to France was laid, the shore ends of which were landed at Dover and Calais respectively.

It was subsequently found that the Admiralty was put to considerable expense in working the mail service, and it was decided to put the overseas carriage of the mails out to contract. This step was taken in 1854. Mr. Churchward, of Dover, was the successful contractor, and his vessels also carried the mails to Ostend in conjunction with vessels belonging to the Belgian Government. Just before relinquishing the service, the Admiralty paid off the "Widgeon" in 1849, which, after acting as tender at various ports, disappeared from the Navy List in 1883. The "Dover," paid off in 1847, was transferred to the Colonial Department, which sent her out to the river Gambia. Of the remaining six vessels, the "Onyx," "Violet," "Ondine," "Garland," "Princess Alice," and "Vivid," the new contractor purchased the first three and for a time hired the "Garland." The "Vivid," after conveying H.R.H. the Duke of Cambridge to Calais on his way to the Crimea, arrived at Woolwich with the "Princess Alice" to be paid off. The latter was immediately commissioned as a despatch vessel with the Baltic Fleet during the war with Russia, and afterwards acted as tender at Devonport until her name disappeared in 1877. The "Vivid" was commissioned as tender to H.M.S. "Fishguard" at Chatham. After seventeen years she was moved to Devonport as tender to the "Royal Adelaide" flagship, and on January 1st, 1890, was commissioned as flagship and depôt, H.R.H. the Duke of Edinburgh at one time being in command of her. In 1892 she was superseded by the "Capercailzie," which was re-named the "Vivid," and when the stone depôt and barracks took the place of the unhealthy hulks, the name "Vivid" was given to the buildings, and as such they are known to this day. The original "Vivid" was put on the non-effective list and was probably sold in 1893, as her name then disappeared from the Navy List.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

NATIONAL TRANSPORT.

SIR,—In his letter in your issue of the 1st inst., Mr. E. Pease very pertinently draws attention to what the contending parties in this throat-cutting "Road *v.* Rail" wrangle invariably ignore—the national interest—and asks what is the best carrier for British products and for the raw material of industry.

The best and cheapest carrier for all heavy goods, including coal—the key product of industry—is, of course, inland water transport, which depends upon water which never wears out.

If we consider what I term the "basic ton-mile rates," *i.e.*, the lowest rates at which road, rail, or canal, can respectively carry a ton of goods 1 mile, we find they can be stated as follows:—

Road transport	2d. per ton-mile
Rail transport	1d. „ „
Modern canal transport	¼d. „ „

These rates err, if anywhere, in favouring road and rail costs, whereas long before the war motor barges were in use on the Continent conveying goods at one-tenth of a penny per ton-mile, all charges included, and carriage by canal at one-fifth of a penny per ton-mile was a commonplace.

It is clear, however, that the cost of canal carriage in modern motor barges is only one-fourth that of rail and one-eighth that of road transport.

It is nothing short of a tragedy that our inland waterways, a splendid network linking up with each other and the coast ports, all our industrial and agricultural centres, should, in spite of the lessons of the war, continue in their lamentable state of neglect, a neglect which must have cost this country hundreds of millions during the war, when nothing over 7ft. beam or 3ft. 9in. draught could navigate across England, much less a 200-ton ammunition barge.

Cost and not speed will always be the dominating factor in transportation, as it is in trade, and our road-making mania has cost us enormous sums without making inland transport any cheaper.

Nor is this all. The more inefficient an inland waterway becomes as a transport medium, the more diabolically efficient it becomes in spreading ruin on all sides by ever more serious and frequent floods. When we reflect that the recent inundations did damage in Derby, Nuneaton, and Bentley alone to the tune of £650,000, a sum which represents two years' interest on something like £6,000,000, our folly comes home to us.

All that is needed to restore the inland waterways to efficiency is through traffic facilities for modern self-propelled motor vessels of economic capacity, say, craft of around 120 tons D.W., which would carry and tow. To that end the Railway Act of 1921 should be amended so that where it is desired to improve and work any canal or waterway for transport, flood prevention, water supply, &c., it may be made compulsorily purchasable if its owners decline themselves to improve it or to sell to, or combine with those who will do so. Private enterprise would thus be able to deal with the waterways on their merits, the State not being committed thereby to any expense whatever.

Considering our unrivalled facilities for the construction of all kinds of inland water transport craft, and pleasure vessels as well, the acute depression in shipbuilding and marine engineering, to which nobody can see an end, and the urgent need of the cheapest inland transport, our willingness to dispense with our 3600 miles of canals and canalised rivers is extraordinary.

G. C. C. HENDERSON (Captain).

Yeovil, July 9th.

"SHORT BELT DRIVES."

SIR,—A note at foot of your second column, page 37, of your current issue, quoted from the *American Machinist*, seems to call for comment, as seeming to import a "mystery" where none exists.

The long belt is compared with the short belt, to the disadvantage of the latter, mainly as regards climatic conditions. I very much doubt whether such conditions have the influence attributed to them as regards the tightness of a belt under ordinary conditions—of course, abnormal conditions sometimes obtain—which are alone considered. If the long belt contracts, due to air moisture, then its dip as a catenary is reduced and its tension at the supports (pulleys) has a smaller ratio to that at the vertex; on the other hand, should it extend, due to dry air conditions, then the dip increases and the ratio of the tension at the supports to that at the vertex increases. Thus the extension or contraction of the belt length has a less influence on the driving power than may be otherwise expected.

With a short belt there is less length to be affected by moisture, and even allowing for the more acute angle made by the belt to the line of centres, there is therefore no reason to anticipate much greater changes of tension due to air conditions in the case of the "short" as compared with the "long" drive.

As a matter of fact, the "short" drive may in most cases be made superior to the "long" if proper use is made of the jockey pulley to increase the arc of contact. Under most conditions, when the question arises which type of drive to adopt, the arc of contact can, as a rule, be easily doubled and often trebled, and with the friction coefficient common with most belt material this increase of arc greatly increases the ratio T_1/T_2 and thus the total load on the belt which determines the size and strength of the belt is proportionately reduced and the question of changes of tension due to atmospheric conditions becomes of small importance.

The long belt drive has an advantage, in the case of its load being "impulsive," due to its greater elasticity, and this advantage is not entirely recovered by the "short" drive, even when provided with a jockey pulley sliding in guides held on rocking arms, owing to the inertia of the jockey pulley, but I may say that I have not come across a case where such a condition is of material importance. It should not be necessary, but I am afraid it is still necessary, to say that the jockey pulley must be applied to the slack side of the belt, since many persons still seem to be unaware of the underlying theory of belt drives, and that the function of a jockey pulley is much less that of a belt "tightener" as that of a means of increasing the arc of contact of belt with pulley. GEO. T. PARDOE.

July 7th.

EXPORT TRADE AND GROUP SELLING.

SIR,—The question of group selling for export, or, in other words, arrangements by British manufacturers for joint representation in overseas markets, has received increasing attention both in the Press and by those concerned with export trade.

I recall in particular the appeal made by H.R.H. the Prince of Wales, on his return from South America last year, for cordial co-operation by industrial units and for more grouping, particularly as regards salesmanship and representation.

The object of such grouping is to assist those manufacturers who cannot individually afford to maintain full-time representatives abroad, to secure the substantial measure of direct representation which is of such importance in connection with overseas marketing.

The British Export Society—which is an organisation for the purpose of dealing in a practical manner with the problems of export trade—has had under consideration this problem of overseas group selling and has drawn up a pamphlet on the subject, containing a preliminary survey of the underlying principles—viewed from a practical standpoint. Mr. John Colville, Parliamentary Secretary of the Department of Overseas Trade, has written a foreword to this pamphlet.

The Society is prepared, in addition, to assist the practical promotion of suitable selling groups. In order, however, to produce the best results, the Society feels that its activities in this matter should not be restricted to its own membership, as there are doubtless many non-member firms which would welcome an opportunity of discussing the problems with other firms similarly interested. Indeed, the lack of co-ordinated thought and action has, in the Society's opinion, hitherto seriously retarded this important development.

I shall, therefore, be glad if you will make it known to your readers that the British Export Society voluntarily offers its facilities to all exporting British firms (whether members of the Society or not) to bring them into touch with other firms producing or handling non-competitive British products, with a view to their co-operation in the formation of selling groups. The Society extends this offer in the general interests of British export trade, the development of which is of such vital importance to the country.

Any firms interested should place themselves in communication with the Secretary, the British Export Society, 21, Tothill-street, London, S.W. 1, from whom copies of the pamphlet can be obtained.

HUGO HIRST,
President, the British Export Society.

London, S.W. 1, June 21st.

FROM STEAM TO SAIL.

SIR,—To the interesting list of steamships converted to sail, mentioned by Mr. G. Aylmer in his article in your issue of July 1st, page 9, should be added the historic "Archimedes," built in London by Wimshurst in 1838 for the Smith's Patent Propelling Company, to demonstrate the advantages of the screw propeller of Sir Francis Pettit Smith. This was the vessel which was tried under Brunel's supervision and the performances of which led him to discard the paddle wheels being constructed in 1843 for the "Great Britain," to which Mr. Aylmer refers, and to fit that ship with the screw. The particulars of the "Archimedes" are given in many books, including the catalogue of the Merchant Steamers, of which there are models or illustrations, in the Science Museum. None of these books, however, give the history of the ship. But from the records of Lloyd's Register, it is seen that in November, 1847, the vessel was surveyed at Sunderland for damage repairs, and at the same time her machinery was removed and she was converted to a sailing ship. In August, 1852, she was surveyed on account of change of ownership, and she was reported to have been supplied with one new set of sails and a great deal of new running rigging. In 1854 or 1855, her classification lapsed and her name shortly afterwards disappeared from the Register Book. The "Archimedes" has a place in history beside F. Symington's "Charlotte Dundas," Fulton's "Clermont," Bell's "Comet," and Parsons' "Turbinia," and it would be of considerable interest to know what was the end of her. HISTORICUS.

July 11th.

The Quarter's Shipbuilding Returns.

FROM the statistics issued by Lloyd's Register of Shipping regarding vessels under construction at the end of June we note that in Great Britain and Ireland there is a decrease of 92,281 tons in the work in hand, as compared with the figures for last March, and that the present total—280,692 tons—is 274,911 tons less than the tonnage which was being built at the end of June, 1931. Further, the figure for June, 1932, includes about 159,000 tons on which work has been suspended—126,000 tons of steamers and 33,000 tons of motor ships. The total of 280,692 tons is lower than any comparable figure hitherto recorded by Lloyd's Register during a period of more than fifty years. Nearly 89,000 tons—representing 31·6 per cent. of the tonnage now in hand in this country—are intended for registration abroad or for sale.

The tonnage now under construction abroad—829,081 tons—is about 96,000 tons less than the work which was in hand at the end of March, 1932. Tonnage, included in this figure, on which work has been suspended amounts only to 3290 tons of steamers and 13,263 tons of motor ships. The five leading countries are:—Italy, 180,565 tons; United States of America, 162,203 tons; France, 128,128 tons; Germany, 103,500 tons; and Sweden, 89,201 tons. The total tonnage under construction in the world amounts to 1,109,773 tons, of which 25·3 per cent. is being built in Great Britain and Ireland and 74·7 per cent. abroad.

In Great Britain and Ireland only 27,956 tons were begun during the last three months, an increase of 2243 tons compared with the very low figure for the March quarter. During the quarter just ended 69,255 tons were launched in Great Britain and Ireland. This figure shows an increase of 33,931 tons over the unprecedentedly low total for the March quarter. Similar figures for abroad are 42,540 tons commenced and 124,871 tons launched, showing a decrease as compared with the previous quarter of 12,005 tons in the tonnage commenced, while there has been an increase of 35,381 tons in the tonnage launched. These figures, however, again reflect clearly the inactivity so widely prevalent in the shipbuilding industry.

The oil tankers under construction in the world amount to 33 vessels of 272,869 tons, of which 6 vessels of 47,216 tons are being built in Great Britain and Ireland, 11 vessels of 74,421 tons in Sweden, and 6 of 72,400 tons in Germany. It is noteworthy that, of the 33 tankers under construction, 31 are motor ships, and that the two steam tankers are both being built in Great Britain. The tanker tonnage now in hand comprises 24·6 per cent. of the total steam and motor tonnage being built in the world.

In Great Britain and Ireland the steam tonnage under construction at the end of June—245,374 tons—exceeded the motor ship tonnage by 211,000 tons. The motor ship tonnage being constructed abroad at the same date—445,662 tons—was nearly 63,000 tons in excess of that of the steamers. Of the vessels being built in the world at the end of June, there are 6 steamers and 21 motor ships of between 8000 and 15,000 tons; 2 steamers and 3 motor ships of between 15,000 and 25,000 tons; and 6 steamers and no motor ships of 30,000 tons and upwards.

The table respecting marine engines shows that the horse-power of steam engines now being built or being fitted on board amounts to about 941,000 H.P., while the figures for oil engines aggregate about 410,000 H.P. The figures for steam engines include 23 sets of turbine engines of about 826,000 shaft horse-power, giving an average

of nearly 36,000 H.P. per set. The horse-power of the steam reciprocating engines—about 115,000 H.P.—is about 8·5 per cent. of the total horse-power of marine engines now being built in the world.

Although affected by the continued reduction in the amount of work in hand, the tonnage in course of construction throughout the world under the inspection of Lloyd's Register reaches 640,798 tons; of this total, 261,529 tons are being built in Great Britain and Ireland and 379,269 tons abroad.

Test Results of a Two-Stage Compressor.

IN our issue of April 22nd this year we described and illustrated a new two-stage compressor developed by Mr. J. Holloway, A.M.I. Mech. E., and constructed by Thomas W. Ward, Ltd., and the Laycock Engineering Co., Ltd., of Sheffield. This compressor has now been tested by Dr. Mellanby, of the Royal Technical College, Glasgow, and we print below an abstract of his report on the test.

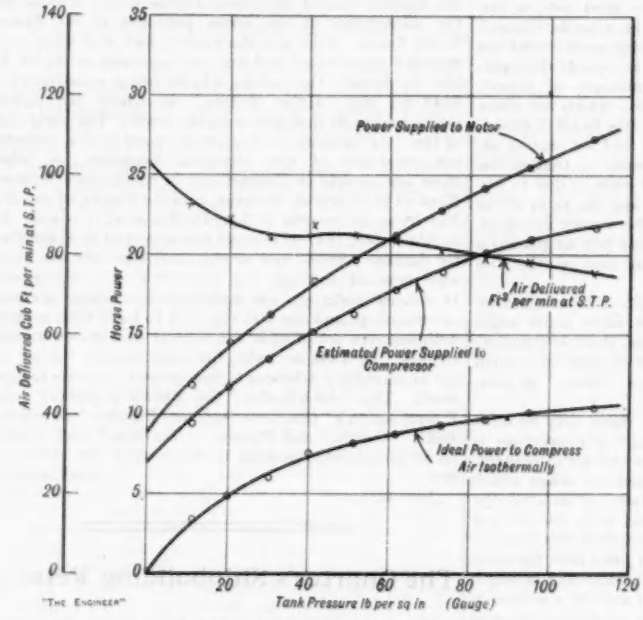

Air Delivered Cub Ft per min at S.T.P.
Horse Power
Power Supplied to Motor
Air Delivered Ft³ per min at S.T.P.
Estimated Power Supplied to Compressor
Ideal Power to Compress Air Isothermally
Tank Pressure lb per sq in (Gauge)
"THE ENGINEER"

FIG. 1—GRAPH OF TEST RESULT

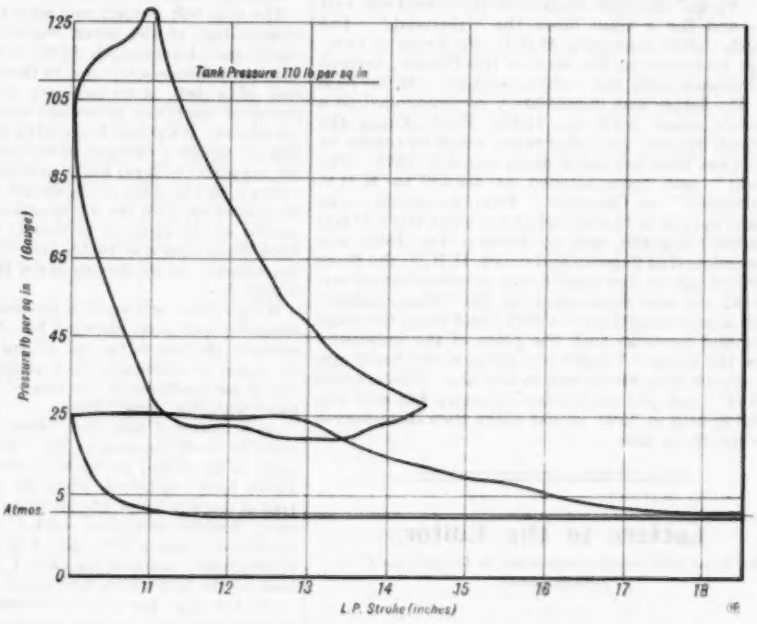


FIG. 2—COMBINED INDICATOR DIAGRAMS

DESCRIPTION OF TESTS.

The tests were carried out in the works of the Laycock Engineering Company, Sheffield, during May 24th, 25th, and 26th, 1932. Three series of tests were carried out, and in each series measurements of the electrical power and of the air delivery were made at pressures rising from about atmospheric to over 100 lb. per square inch gauge.

After running Test I. an alteration was made in the connection between the upper piston and the crosshead, thereby producing a different value of low-pressure to high-pressure cylinder ratio. After running Test II. a further alteration was made, so that the three tests represented three different cylinder compression ratios.

TEST RESULTS.

The main features of the test results are given in the accompanying Figs. 1 and 2. The results from Test II were found to be the most favourable, and consequently this series of tests has been taken as representative of the performance of the compressor.

An analysis of Test II. is shown in Fig. 1. Here an estimate has been made of the motor and belt losses, and the two curves showing horse-power input to the motor and horse-power delivered to the compressor have been drawn. It should be noted that there is some possibility of error in the estimation of the belt losses, and that the horse-power delivered to the compressor may be slightly above or below the values shown by the curve.

On Fig. 1 are also reproduced the air quantities delivered during Test II., and a further curve showing the indicated horse-power under the ideal conditions of isothermal compression, no clearance and no wire drawing losses, is also included. Fig. 1 thus gives a fairly complete picture of the compressor performance under the best conditions of the three days' testing.

Fig. 2 shows an indicator diagram drawn to a common pressure and volume scale, when the pressure in the tank was about 110 lb. per square inch gauge.

CONCLUSIONS FROM TESTS.

From the mechanical point of view, the working of the compressor was all that could be desired, and the general impression given was that it ran more smoothly and quietly than the normal two-stage, single-acting compressor. The curves of air delivery indicate that the amount of air compressed per minute fell off as the delivery pressure increased. Part of this reduction can be accounted for by the reduced revolutions of the motor with increasing load. The remainder of the reduction is due to the diminishing volumetric efficiency of the low-pressure cylinder as the delivery pressure increased. Some of this reduction is caused by the higher intermediate pressure which results in a greater quantity of air being left in the low-pressure clearance space. The other appears to be due to leakage back to the cylinder during the suction stroke. This view is supported by an examination of the indicator cards, and it is possible that the low-pressure delivery valve may be rebounding from its seat. The indicator card of the high-pressure cylinder also suggests a back leakage, and here, again, the possibility of valve chattering should be considered. This high-pressure cylinder leakage by raising the intermediate pressure contributes its share to the loss of volumetric efficiency in the low-pressure cylinder.

Canadian Engineering News.

The Hydraulic Mining of Peat.

IT is announced that United Peat Industries, Ltd., Montreal, has installed and placed in operation at St. Hyacinthe, Quebec, a plant for the recovery of peat fuels and humus from large bogs in that neighbourhood. The process, imported from Denmark after successful operation in that country, involves the principles of hydraulic mining. It is believed that this method has decided advantages over the excavation methods formerly employed in Canada in Government and private experimental work on the recovery of peat.

Canadian and Imported Coal.

To encourage the greater use of Canadian coal in the manufacture of coke or gas, the Canadian Government has decided to pay any difference between the cost of imported and Canadian coal up to 1 dollar per ton. The text of an Order in Council discloses that such payments to coal operators, however, shall be made only upon that quantity of Canadian coal used in the manufacture of coke or gas at the plant in excess of the average quantity of coal used annually in such plant during the three years immediately preceding December 31st, 1931. The payments are to apply to coal mined in Canada and transported to and used in any coke or gas plant in Canada during the period fixed by the Order in Council.

Heat Conductivity of Building Materials.

During the last year the National Research Council of Canada designed and constructed a testing apparatus of the hot plate type for measuring the heat conductivity of building materials. It consists of two outside cold plates and a central hot plate. The plates are 18in. square and permit the use of a 3in. guard ring around an effective heat-transmitting surface 1ft. square. The cold plates are kept cool by the circulation of brine pumped from an electric refrigerator. The difference of temperature between the hot and cold plates is measured by copper-constantan thermo-couples by means of a potentiometer. The apparatus is now working very efficiently and the results it gives on standard materials agree with reliable published results. An extended investigation of Canadian heat-insulating materials is in progress.

Canada's First Butane Gas Plant.

The city of Three Rivers, Quebec, has obtained a domestic gas supply by the opening of what is stated to be Canada's first butane gas plant. The plant is one of the most modern in the liquid petroleum gas industry and the largest butane-air gas plant in the world. Its operation is completely automatic. Liquid butane is shipped to the plant in tank cars with a capacity of 10,000 gallons and the storage tank has a capacity of 21,000 gallons. The gasholder, 45ft. in diameter, holds 92,400 cubic feet of gas at 30 lb. pressure. The designing of the plant was under the direction of E. H. Collins, of the Carbide and Carbon Chemicals Corporation, New York. The gas produced is stated to be non-poisonous and non-toxic, while danger from explosion is minimised.

Large Artificial Lake Contemplated.

The Saskatchewan Government is conducting a survey of the proposed Souris River development, near Estevan. The scheme, which involves the construction of a large artificial lake in Southern Saskatchewan, is also of vital interest to dwellers along the Souris River in the State of North Dakota, United States, from the point of view of flood control, and the Federal Government of the United States has appropriated a sum of money to finance a survey south of the international boundary. The project would necessitate the building of a large earthen dam, about 1960ft. long by 40ft. high, which is expected to create an artificial lake nearly 35 miles long and half a mile wide. Some 8200 acres of land would be flooded, and approximately 44,000,000 gallons of water impounded.

New Tube Mill.

The new tube mill of Anaconda American Brass, Ltd., situated near Toronto, will be placed in full operation on July 1st. The new plant, for production of brass and copper tubes, is the first of its kind in Canada and one of the most up-to-date on the continent. The mill will produce tubes of from ¼in. outside diameter to 5in. inside diameter. Production, it is estimated, will be about 300,000 lb. per month. With the setting into operation of the tube mill the Anaconda plant becomes a complete unit for the manufacture of raw metals and alloys into the finished product. All metals with the exception of tin, which is not procurable in Canada, will be supplied by Canadian mines.

SIXTY YEARS AGO.

IT is difficult perhaps in these days to believe that anyone could derive thrills and excitement from the Royal Agricultural Society's annual shows. Yet sixty years and more ago these events were responsible among engineers for the display of tense interest and keen rivalry. Those were the days in which the Society held annual trials of engines and other equipment, and the modern engineer may well be reminded of the debt which the testing of steam engines in a scientific manner owes to the Society. We went to considerable pains to inform our readers of the details of the equipments and engines tested and of the results which they gave. Our correspondent despatched daily letters to us from the show ground, and in a last-minute telegram sent off on Thursday evenings would give us the latest news of the progress of the trials. In 1872 the Society held its Show at Cardiff. The chief items of interest in the competitions of that year were portable steam engines. In our issue of July 19th we printed our correspondent's report on the trials. The tests were run not without mishap and disappointment to some of the competitors. Messrs. Tuxford's engine, for example, took over 2½ hours to get up steam—80 lb.—and had hardly started on the brake before it split the boss of its fly-wheel. Wrought iron hoops were applied, but one of them cracked and in something like despair the makers borrowed a fly-wheel from another exhibitor. The judges were, however, inflexible, and would not admit the engine to further trial. Interest then passed to the Davey, Paxman engine. This engine was fired by Mr. Paxman himself, and gave, it seems, an excellent account of itself, except in so far that one of the crank shaft bearings, having been inadvertently adjusted too tightly, ran hot for half an hour. Brown and May's engine was distinguished by the fact that it had a lagged smoke-box, for what reason Mr. May himself did not seem to be quite certain. It ran well in spite of a faulty adjustment of its valve rods. Mr. Lewin's engine had to be stopped after a three hours' run because of a hot bearing. The Reading Ironworks Company's engine was fired by James Moody—"the best fireman I ever saw," as our correspondent described him. For nearly five hours the pointer on his steam gauge did not alter the tenth part of an inch. Its performance was so closely equal to that of the Clayton and Shuttleworth engine that the judges decided that the two engines should each be given a second run. On the following day the Clayton engine beat its own record. The Reading engine was unable to compete, because Moody had taken cold and was "utterly incapacitated for work." The Clayton engine was awarded the first prize and the Reading engine the second.

Railway and Road Matters.

ANSWERING a question on July 6th, Mr. Pybus said, in respect of the London Passenger Transport Bill, that in view of the additional expenditure, both public and private, and the delay which the introduction of a new Bill would involve, he was of opinion that the proper course was suitably to amend the existing Bill.

AS a London and North-Eastern passenger train was ascending the steep gradient from the Metropolitan Railway at King's Cross to the L. and N.E. main line on Friday, July 8th, the train evidently came to a stand for some reason, and set or slid back. A London, Midland and Scottish goods train was at the time proceeding from Kentish Town towards the City, and the passenger train backed into it.

ON the second day of the annual meeting of the National Union of Railwaymen a resolution was carried unanimously in favour of a comprehensive national organisation of all forms of transport under public ownership and control. The mover of the resolution said that the unfair competition of road transport was causing the railway companies to seek reductions of working cost at the expense of the workers.

THE extension of the use of Sentinel-Cammell coaches and of steam rail cars is feared by Mr. Cramp, of the National Union of Railwaymen, who in his report to the annual general meeting of the N.U.R., held at Folkestone during the week commencing July 4th, said that the development of the small power unit for certain passenger working was bound to continue. The question is of importance to the Union as only one engineman is required.

THE report on the Vote for the Ministry of Transport on Thursday, July 7th, furnished an opportunity for criticising the formation of the Committee which is considering the L.M. and S. and the L. and N.E.R. pooling scheme. It was urged that the investigation should have been undertaken by a wider body than the same three persons who formed the Railway Rates Tribunal. It was also urged that nothing be done until the L.M.S. and Great Western scheme had also been considered. Mr. Pybus defended his actions and the Vote was carried by 318 votes to 39.

ON Sunday last there was a head-on collision between two trains on the miniature railway belonging to the Corporation of Scarborough. As this was not a railway accident within the usual meaning of that term, we should not have mentioned it herein had not the inquiry been made as to whether the facts would be investigated by the Ministry of Transport. As this was a line on private property, it would not be subject to that Department, either as to its inspection before opening or in the reporting of accidents. Being the property of the Scarborough Corporation, such an incident is, however, a matter of local government that comes under the notice of the Ministry of Health, and we understand that that Department will hold an inquiry. Moreover, as one of the drivers was unfortunately killed, there will be a coroner's inquest, and all the facts will be brought out there. That was opened on Tuesday and adjourned until July 26th.

THE inquiry into the proposed pooling arrangements between the London, Midland and Scottish and the London and North-Eastern Railways by a committee appointed under the Railway Act, 1921, by the Minister of Transport, was commenced on June 28th, and concluded on Tuesday last, July 12th. It had a very hopeful ending; Mr. Bruce Thomas, on behalf of the companies, gave an assurance that they would not withdraw any important facilities without prior consultation with the trading interests concerned. Mr. Jacques Abady, representing the traders, thereupon withdrew their opposition, and the scheme goes forward with their support. Mr. Bruce Thomas could not, however, meet the wishes of the men's trades unions as to compensating men who were found to be redundant. The companies would undertake not to dismiss, as a consequence of the pooling, anyone in their service on July 1st, 1932, but that was not to prevent them accelerating the age of retirement or from transferring the staff from one position to another or reducing them in grade with or without a reduction in salary.

AN incident, which is not without its amusing side, occurred during the journey of the 5.45 p.m. express from King's Cross to Hull on June 17th. According to a question addressed to Mr. Pybus on Thursday July 7th, a passenger pulled the communication cord at a certain station, but the train failed to stop. The explanation offered by the railway company was that the passenger threatened to pull the cord if the train did not stop as he requested, at the station, so the officials arranged that the signal be ignored. Mr. Pybus added that he did not propose to take any action in the matter. As the incident may arouse interest as to the working of what is still called the cord communication, we would say that for many years there was an agitation, supported by the Board of Trade, for communication between passengers and the servants in charge of the train, and "efficient means of communication . . . as the Board of Trade may approve" was ordered by the Regulation of Railways Act, 1868—31,832, Vic., c. 119. The South-Eastern adopted an electrical system, but most companies had the cord system, originated by that eminent engineer, T. E. Harrison, of the North-Eastern Railway. It was approved by the Board of Trade on February 27th, 1869, and officially sanctioned on August 1st, 1869. As it constantly failed, the sanction was annulled on January 1st, 1873. It remained, however, the principal means of communication until in 1890 the M.S. and L.—afterwards the Great Central—introduced the system now universally employed. It was approved by the Board of Trade in 1893, and after an investigation by a Departmental Committee the Board formally condemned the cord system in July, 1898, and in the summer of 1899 all the companies adopted the Great Central method. It consists of a chain in each compartment which, when pulled, slightly applies the vacuum brake. That attracts the driver's attention, who then takes steps to stop the train. If he thinks it safer to run forward to the next signal-box, he can release the brake. Such a release was evidently effected on the occasion now in question.

Notes and Memoranda.

ACCORDING to a recent issue of *Steel*, the life of chromium-plated tools, such as files, twist drills, reamers, die-blocks &c., has been increased by as much as fifteen times.

THE coalfield in the Klip River Valley, Transvaal, which is to be worked by the Randfontein Estates G.M. Company, Ltd., is said to be 203ft. thick, covered with an overburden of 311ft.

ALUMINIUM has been used in the construction of the dome of the new conservatory of the U.S. Botanic Gardens, Washington, largely to reduce maintenance costs, especially in the lofty parts, which are difficult of access and are exposed to a moist atmosphere.

WRITING in *The Central*, Mr. H. F. P. Purday points out that "the shop trials of a Diesel engine of 10,000 B.H.P. are usually completed within twenty-four hours of its first revolution under compressed air. This may interest those who remember the long period of 'tuning up' which was required by Diesel engines of 200 or 300 horse-power, or less, in earlier days."

A NOTE numbered Technical Paper No. 282 has been published by the Manager, Government of India, Central Publication Branch, Calcutta, dealing with the salvage of timber railway sleepers which would otherwise be useless on account of damage to the spike holes. The report, which is priced at six annas, describes some compositions for making the spikes secure again, their mode of use, and the results that may be expected from them.

THE Research Council of Alberta reports a discovery which will cheapen the extraction of oil or bitumen from the McMurray tar sands. For some years research has been carried on into methods of separating oil from the bituminous sands which are a very extensive resource in the Athabaska Valley, Northern Alberta. The investigators, Dr. K. A. Clark and Dr. D. S. Pasternack, now report that practically 100 per cent. of the oil or bitumen can be recovered by using a solution of soda ash.

THE metal gallium is liquid at all temperatures above 86 deg. Fah., and with careful alloying can have its freezing point depressed even below "room" temperature. It is far less volatile than mercury, and can be used in direct reading thermometers made of quartz which function to above 700 deg. Cent. (bright-red heat), whereas the upper limit for mercury is about 350 deg. Cent. In vapour-type electric lights, it produces light rich in red rays. It works well with other metals, and makes fine amalgams possibly useful in dentistry.

A NEW cobalt-iron alloy being manufactured by Darwins, Ltd., of Sheffield, contains 30 to 40 per cent. It is characterised by extremely high flux densities at moderate magnetising forces. The alloy is intended for incorporation in magnetic circuits required to produce very high-flux densities across narrow air gaps. It is claimed to be suitable for pole pieces and apparatus for the interconversion of electrical and mechanical energy, such as are used in sound-recording and reproducing apparatus, particularly where excessively high magnetising forces are not desirable.

THE possibility of the commercial production of nickel steel direct from the nickel-copper ores of the Sudbury District, Ontario, is said to result from recent researches in the laboratories of the Department of Mines, Ottawa. In a bulletin on "The Semi-direct Production of Nickel Steel from Sudbury Ore," the authors, T. W. Hardy and H. H. Bleakney, reveal that nickel-iron sponge has been made successfully in a direct process from the ore, and the sponge was used in the production of nickel steels, which compared favourably in physical or strength tests with nickel steels made in the ordinary way.

AN investigation has been undertaken by the Cleveland Twist Drill Company in co-operation with the U.S. Bureau of Standards, with the idea of minimising, so far as possible, variables due to complex composition, and difficulties heretofore encountered in the mechanical testing of hardened steel. The material chosen was a simple carbon tool steel, and the tests followed a mechanical method which has proved especially suitable for this class of material. In this way it was hoped that some clue might be obtained as to the fundamental relationships between the magnetic and mechanical properties. Magnetic and mechanical tests were made on a series of specimens subjected to various heat treatments intended to cover the range commonly regarded as useful for this steel, with some overlapping beyond the regions of usefulness. An important conclusion drawn from the results is that each property determined has its own individuality, distinct from that of the other properties.

IT is not always realised, states a writer in the *Electrical Times*, that heating troubles can occur in condenser insulators if care is not taken in the arrangement of the earth connections. A condenser insulator consists of a number of concentric cylinders in the form of metal foil, separated by insulating material of treated paper, the whole being wound upon a central conducting-rod or tube. The foils form a system of condensers in series, and are so proportioned that the voltage may be suitably graded from the inside high-voltage conductor to the outer earth band. It is not usual to treat the earth band as the last conducting layer of the insulator, but to join the last foil layer to the earth band with soldered connection. In order to ensure good earthing, two such connections are sometimes made, one at each end of the last foil. It is then that trouble may occur. Each foil layer has induced in it an electromotive force in an axial direction due to the magnetic flux set up by the central conductor. It is true that this electromotive force is small, probably less than 1 volt, but it is evident that in a circuit consisting of a foil layer, two wire connectors and an earth band, the impedance is low enough to allow considerable circulating current to flow. This trouble has been encountered at times in practice, and is entirely due to the use of duplicate earth connections. It should, therefore, be realised that condenser insulators have small electromotive forces induced in the foil layers in an axial direction, and care should be taken that no closed circuits are formed in which these electromotive forces can give rise to circulating currents.

Miscellanea.

MANCHESTER has thirty heavy-oil engine omnibuses in service and thirty-five more on order.

A DUTCH firm has acquired premises in Hull for the manufacture of electric incandescent lamps.

THE White Star liner "Laurentic" is to leave Liverpool in September as a trader ship on a visit to Canada.

COAL-BUNKERING appliances of the Mitchell type are to be put up at the new deep-water wharf at Sunderland.

A VIRTUAL monopoly of marine salvage over the area comprising the Dardanelles and its approaches and the Bosphorus has been granted to a Turkish company by vote of the National Assembly.

ANACONDA AMERICAN BRASS, Ltd., has nearly completed its new tube mill at New Toronto, the first of its kind in Canada producing brass and copper tubing $\frac{1}{2}$in. outside diameter to 5in. inside diameter. The production will be about 300,000 lb. per month.

IT is proposed to dam the Columbia River, near Spokane, Washington, for the purposes of irrigation and the generation of power. The dam would be 420ft. long, and would permit the generation of 800,000 kW. The area to be irrigated measures about 80 by 80 miles.

ACCORDING to a return issued recently by the German State Statistical Department, the number of electricity undertakings in Germany increased during the past year from 201, with a total capital of £105,050,000, to 204, with a capital of £120,550,000. Of the last-mentioned sum, twenty-four undertakings were responsible for £83,300,000.

SOME trials have been carried out by the Société des Tramways d'Anvers with an electric trolley omnibus in the Antwerp district. In a report just issued it it is stated that the tests have proved so satisfactory that it has been decided to apply to the muncipal authorities for permission to replace by trolley vehicles the petrol omnibuses running on one of the dock services.

A TRACT of land, of 6000 acres, to be known as the Swain Experimental Forest, where forestry experiments and research can be carried on, has been set aside near Westwood, Calif., in the Lassen National Forest by order of the Chief Forester in Washington. The tract contains more than 3000 acres of red and white fir timberland on which both mature and small trees are available for future experiment in forestry methods.

THE Board of Patrons of the James S. Dixon Chair of Mining in the University of Glasgow and the Governors of the Royal Technical College, Glasgow, have appointed Mr. Andrew M. Bryan, B.Sc., M.I.M.E., Newcastle-on-Tyne, to the James S. Dixon Chair of Mining in the University and the Professorship of Mining in the Royal Technical College. Mr. Bryan has been one of His Majesty's Senior Inspectors of Mines and Quarries in the Northern Mines Inspection Division.

THE Birmingham Corporation proposes to abandon a portion of the Coventry-road tramway system and to substitute fifty trolley omnibuses. Although on many of the suburban and other routes the petrol-driven omnibuses are very popular, the Committee makes it clear that it does not intend to enter into a wholesale abandonment of tramways, but only to deal as occasion arises with routes where it would be unremunerative to reconstruct the track. The scheme will cost £95,000.

THE Rand Water Board is ordering plant for additions and alterations to its various stations, at a cost of £19,350, as follows:—Boiler plant accessories at Zwartkopjes and Vereeniging; additional transformer, Zuurbekom; steam turbine-driven generator, Zwartkopjes; replacing three centrifugal pumps, Zuurbekom; additional steam range, Vereeniging. These renewals and extensions form part of the proposals submitted by the chief engineer involving various alterations to the Board's plant and pipe line system. The major part of these suggested works, however, is being held over for further consideration.

THE official returns rendered to the Electricity Commissioners show that 822 million units of electricity were generated by authorised undertakers in Great Britain during the month of June, 1932, as compared with the revised figure of 776 million units in the corresponding month of 1931, or an increase of 5·9 per cent. During the first six months of 1932 up to the end of June the total amount of electricity generated by authorised undertakers was 6089 million units, as compared with the revised figure of 5639 million units for the corresponding period of 1931, representing an increase of nearly 8 per cent.

ACCORDING to the monthly report of the National Federation of Iron and Steel Manufacturers, there were sixty-nine furnaces in blast at the end of June, the same number as at the beginning of the month. The production of pig iron in June amounted to 311,400 tons, compared with 315,300 tons in May and 323,800 tons in June, 1931. Production includes 75,700 tons of hematite, 130,100 tons of basic, 85,500 tons of foundry, and 13,200 tons of forge pig iron. The output of steel ingots and castings in June amounted to 459,300 tons, compared with 416,900 tons in May and 428,900 tons in June, 1931. The figures for May, 1932, and June, 1931, were affected by Whitsun holidays.

SIX new wireless transmitting and receiving stations are to be erected near Shanghai for the operation of the proposed short-wave beam services between China and Europe and the United States of America. The equipment of the new stations will include two beam transmitters and four sets of receiving apparatus, all of which are to be manufactured at the Marconi Works, Chelmsford, to the order of the Chinese Government. For the commercial telegraph services to Europe, of which the principal is the service to Great Britain, two bays of beam aerials are to be erected, one being tuned to the wavelength of 17 m. and the other to 26 m. A third beam aerial will be directed on San Francisco for the American service. In addition, there will be four omni-directional aerials, one of which will be used for broadcasting. At the receiving station four high-speed commercial service receivers of the Marconi beam type are to be installed. These stations will provide for the first time a direct commercial wireless circuit between Great Britain and China.

THE SEWAGE DISPOSAL WORKS OF THE CITY OF BRADFORD

(For description see page 54)

FIG. 4—AERIAL VIEW OF DETRITUS AND STORM WATER TANKS

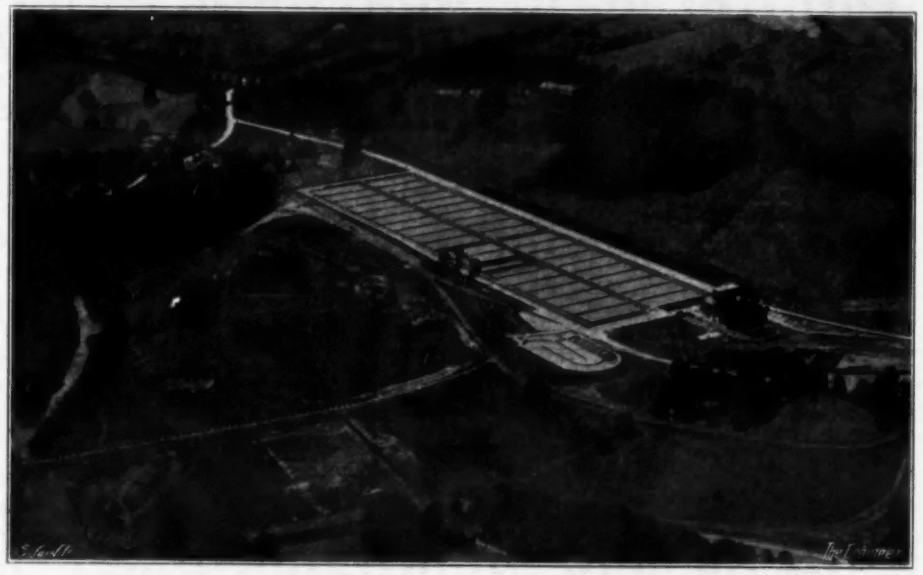


FIG. 5—AERIAL VIEW OF PRECIPITATION TANKS AND SULPHURIC ACID PLANT

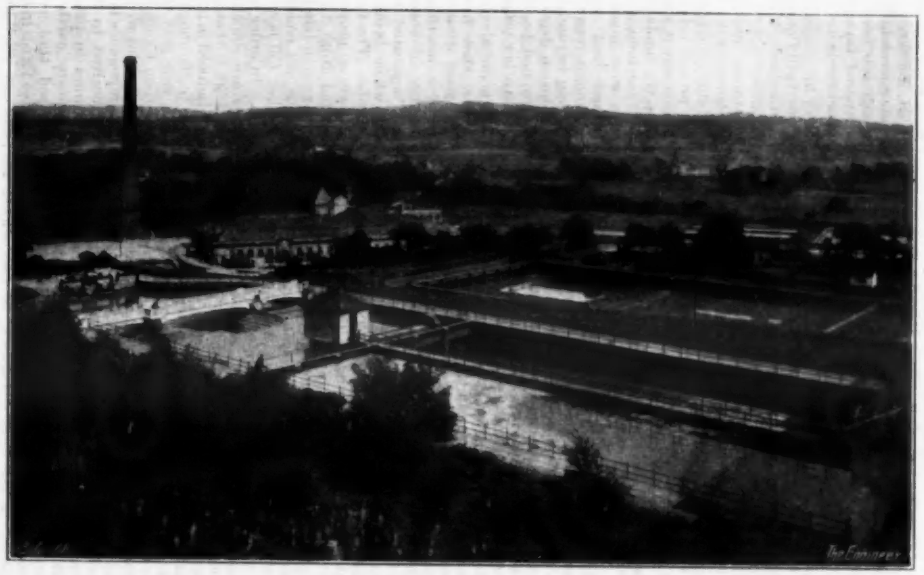


FIG. 6—DETRITUS TANKS AND STORM WATER BAY

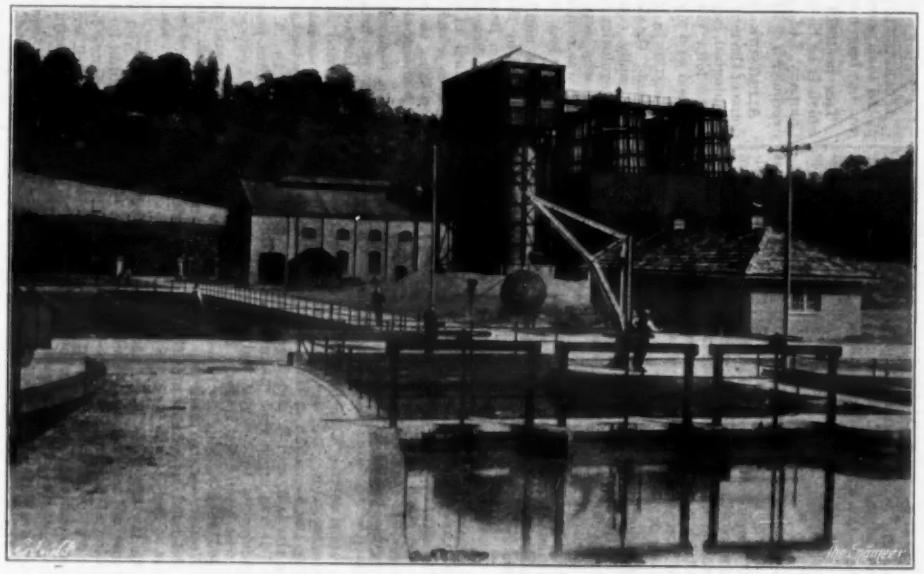


FIG. 7—PRECIPITATION TANKS AND SULPHURIC ACID PLANT

The Engineer

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AMERICAN WORKS IN GREAT BRITAIN.

LONG before there was a direct fiscal inducement to do so, American manufacturers established works in the United Kingdom, or closely allied themselves with British interests. One of the advantages secured thereby was the enjoyment of the preferences given by the British Dominions to home manufacturers. Now that this country is protected by a tariff wall, a new factor is introduced, for not only do the Dominions give a preference to Great Britain, but Great Britain gives a preference to them. In fact, the Empire as a whole has set up a barrier, of limited height, against all foreign nations, America included. To get within this protective circle the United States has adopted a very obvious course. Instead of exporting direct to this country, it exports *vid* Canada, and secures thereby the preference given to that Dominion. Under an existing regulation, however, 25 per cent. of the labour content of all products must be Canadian, and to meet that requirement it is reported that, already, 150 American branch assembly plants have been erected in Canada. It is by no means easy to ascertain or to ensure that not less than 25 per cent. of the labour is actually Canadian, and there is reason for believing that it does not invariably attain the stipulated level.

Whilst we may rejoice that Canada is receiving these additions to her labour market, we cannot close our eyes to the fact that at least 75 per cent. of the work which is benefiting by Empire preference is performed by a foreign country, which, therefore, is enjoying the greater portion of a privilege intended for the Dominions. To get over this objection an endeavour is being made in certain quarters to induce American manufacturers to set up new works in this country. According to a report just made by Mr. William Watson, Chairman, New Industries—Home and Overseas—Committee of the Scottish National Development Council, one firm has agreed to do so under terms which Mr. Watson regards as presenting a test case. The firm in question has laid the following proposal before the Import Duties Advisory Committee. It now exports to Great Britain through a Canadian assembly plant, but it expresses its willingness to set up a factory in this country provided the Government will allow a reduction of the duties on the assembly parts in their raw and unfinished state—as affecting the industry as a whole with which the firm is connected—for one year. In that year the firm would equip and organise a British factory and train men and women workers for what is described as a highly specialised production. Moreover, the present 25 per cent. Canadian labour content would be continued during the year of grace plus 40 per cent. British. As soon as the factory was in full running order the output would be produced wholly by British labour. Mr. Watson, who has recently returned from America, reports that if this scheme is accepted by the British Government, it will be followed by others of a similar nature. Accepting Mr. Watson's report upon the American attitude, it obviously raises very nice questions which will not only exercise the intelligence of the Import Duties Advisory Board and the home Government, but will call for the consideration of the Ottawa Conference on a question of principle. A manifest objection to the plan is that it would rob Canada of industries for the benefit of this country. Mr. Watson minimises that loss, but, in the absence of statistical facts as to the number of persons employed and the sums of money expended it is impossible even to guess at the Canadian reaction. It is not difficult to imagine that she will ask why, if the works are to be established within the British Empire, they should not be established in Canada instead of in the United Kingdom? She might say that rather than reduce temporarily the tariff in favour of the American firm, the 25 per cent. labour content provision might be raised to a much higher figure—even 100 per cent.—and so ensure that Canada enjoyed the full benefit. No doubt it is such considerations as these that have caused a minute on the proportion of work necessary in order to secure Dominion preferences to be included in the agenda for the Ottawa Conference.

But there is another consideration which bears upon this case, and upon many other similar cases, which is receiving less attention, perhaps, than it deserves. In our rejoicing over the increased capacity for the absorption of labour which the building of works by foreign firms in this country presents, we cannot safely neglect to ask ourselves if such works will compete with existing British works, or, and this is an important point, if they will tend to prevent developments which would enable factories which are now short of orders to work to capacity. We are not informed by Mr. Watson what the nature of the undertaking to which he refers is, but we do say that if the industry is one which is already established in this country, and which is big enough to satisfy the market, the entrance of a further competitor, on whatever terms, should not be encouraged without the fullest investigation. We must, indeed, look further than to the immediate good which is done by the expenditure on buildings and equipment, remembering on the one hand that the profits secured by the new firms may be taken from the old, and, on the other, that the net profits will go into foreign hands.

Electrical Accidents.

THE report of the Senior Electrical Inspector, embodied in the recently issued report of the Chief Inspector of Factories and Workshops for 1931, shows that the reportable electrical accidents for the year numbered 321, and that 22 were fatal. As for the years 1921–25 inclusive, the average number was 368, and for the period 1926–30, 383, the figure cannot be regarded as unsatisfactory, especially when it is remembered that every year shows a substantial increase in the use of electricity. The scarcity of serious accidents is a matter in which manufacturers and others can take pride, but it must not be imagined that a state of finality has been reached; for apart from any other consideration, it is to be remembered that these publications do not cover all the accidents that occur. Twenty-six accidents, including nine fatal, which were notified proved on investigation to be non-reportable, and in addition thirty-five electrical fatalities which occurred in places other than factory premises came unofficially to the knowledge of the Department, the total known "fatalities due to electricity" therefore being sixty-six. Fourteen fatalities appear to have occurred on premises of a domestic character. Only accidents which either cause loss of life to persons employed in a factory or disable any such persons for more than three days from earning full wages at the work at which they were employed need be reported to the Inspector of the district, and it will therefore be seen that whilst these reports give a useful indication of the trend of affairs, so far as factories are concerned, they are apt to obscure the true position as a whole. Nevertheless, even when every case is taken into account, the number of electrical accidents which occur in this country each year is to be regarded as small.

Switchgear operating at pressures below 650 volts was again responsible for the largest number of accidents, although the "fusegear," included under this heading in last year's table, has now been tabulated separately. Defects in the insulation of cables and flexibles were responsible for the next highest number of accidents, including four fatalities, the investigation of which disclosed the fact that the maintenance arrangements were casual, depending mainly on the observation and action of non-technical people. Although from time to time much attention has been paid in these reports to the question of increasing the safety of portable electrical apparatus, it still appears to constitute an appreciable source of danger. During 1931 apparatus of this nature was responsible for six fatal accidents, the same number that was reported during the preceding year. Uncertainty of earthing, coupled with the good contact which the operator is bound to make with portable machines, are the main factors leading to these fatalities. There may, of course, be discontinuities of the earthing connection at the point of attachment in the flexible conductor at the plug or in the subsequent path to earth. The rough usage to which electric tools are often subjected causes a much larger number of failures than is experienced in other electrical plant, and the Inspector again emphasises the desirability of reducing the pressure in the case of special classes of work or industries. Now that A.C. is much more generally used than hitherto there is increased danger, but, on the other hand, there is the facility for transformation to a lower voltage. While it is by no means suggested that pressure reduction is universally desirable, it is strongly emphasised that under certain conditions it is the best and easiest method of securing a proper degree of safety. Light portable transformers enclosed in stout teak cases, and intended for supplying portable apparatus, are now obtainable from British firms, which are probably prepared to meet specific requirements. Although during the period covered by the report no fatalities were recorded in connection with unskirted screw lampholders in factories, it is well known that these holders have been responsible for fatal accidents in the past. The fully skirted type of holder is now in considerable demand, and several manufacturers have brought out inexpensive forms of skirt extensions which are capable of quick and easy attachment to existing holders of the original type. All the typical accidents which the Inspector describes are instructive. As previous reports have shown, mistakes are not made by inexperienced people alone. An engineer and manager of an electricity undertaking was electrocuted during the year as the result of a very foolish procedure. The accident was not witnessed, but evidence points to the fact that he entered a live transformer chamber to inspect or measure the insulators, and burn marks indicated that he must have touched the live conductors whilst passing below them. Although every year the majority of fatalities occur naturally at A.C. pressures between 200 and 250 volts, since these are the voltages commonly used on consumers' premises, there are always cases of shock at much higher pressures which do not prove fatal. During 1931 six cases of non-fatal shocks at pressures above 1500 volts and three cases above 6000 volts were recorded. Beyond suggesting that the duration of the shock and the total resistance of the circuit were decisive factors, it is difficult to advance any explanation of these results, just as it is sometimes difficult to explain why people are killed by very low pressures. While the "Grid" has not, of course, had the effect of increasing the danger of electricity, so far as shocks received on consumers' premises are concerned, the Inspector is obviously a little anxious about the breaking capacity of switchgear on some factory premises. Great expense, he says, has been incurred in connection with main switchboards, but much remains to be done in regard to secondary station switchgear and that associated with consumers' installations. Switchgear that has become inadequate for the job as the result of the "Grid" is a source of danger which must not be ignored.

Despite the fact that electrical accidents have

not been numerous in the past, some engineers appear to be rather uneasy about the future, when electricity is extensively used in rural areas. Although Colonel Crompton is reported to have stated that the introduction of 220 volts A.C. into rural areas abroad has been attended with disastrous results, it is very doubtful if there will be any change of policy here. Rural distribution in this country is already too expensive and the prospects of reducing the pressure and increasing the current are very remote. The alternative is, of course, to employ a relatively high distribution voltage, and instal transformers on consumers' premises, but British engineers do not seem to favour that scheme. If by any chance the number of accidents with the standard system of distribution should prove excessive in rural parts, possibly the scheme of protection described in Mr. T. C. Gilbert's book on "Artificial Earthing for Electrical Installation," reviewed in our issue of April 29th, would overcome the trouble. In this system protection against leakage has been divorced from the overload devices, and small leakage currents of a few milliampères are sufficient to open the circuit. The apparatus is said to have been put into use on over 100,000 installations abroad, but whether it will ever find a wide field of application in this country remains to be seen.

Oil-Coal Fuel for Steamships.

By HENRY LOUIS, M.A., D.Sc.,
Assoc. R.S.M., F.I.C., M. Inst. C.E., &c., Past-President of the Institution of Mining Engineers, &c.

Now that the Cunarder "Scythia" has got back to Liverpool from her voyage across the Atlantic, a few more details about the result of her experiment on the use of a mixture of coal and oil instead of oil alone for firing one of her boilers are available. The idea that a mixture of oil with finely ground coal, in such proportion as not to increase beyond reasonable limits the viscosity of the oil, should be a practical possibility as a boiler fuel has for some time past been present in men's minds and has, from time to time, been made the subject of experiment, not, as a rule, attended with any great measure of success. The idea was clearly and definitely voiced by a well-known North-country mining engineer, Colonel W. C. Blackett, some nine months ago, at a meeting of the North of England Institute of Mining and Mechanical Engineers. Colonel Blackett's words were as follows:—"Even if it were desired to avoid all the dust nuisance in ships, could this not be done, on the fifty-fifty principle mentioned, by oil and coal-dust mixed and pumped into tanks as now are used? It would seem a comparatively simple task for such brains to prevent the dust settling out of the oil and keep the mixture pumpable. After all, this would use half coal, and who knows whether much more than half could be used in the form of the 'paste' mentioned and pushed as such, instead of pumped as oil?"* This suggestion was evidently very close to the accomplished facts, because the mixture actually used on the "Scythia" is stated to have been 40 parts of coal to 60 parts of oil. No doubt such a mixture would be slightly lower in calorific power than oil by itself, seeing that the calorific power of oil averages about 19,000 B.Th.U., whilst the calorific power of coal averages only about 14,000 B.Th.U. On the other hand, fuel oil, taken even at a cost as low as 1½d. per gallon, would cost about 31s. per ton, whilst bunker coal averages about 13s., so that the B.Th.U. in the form of coal is cheaper than in the form of oil, and, therefore, such a mixture would be more economical than oil alone with respect to the heat units which it is capable of generating. Of course, the cost of grinding the coal to the requisite degree of fineness must be added, but if this operation is performed on a reasonably large scale the cost should surely not exceed 5s. per ton, and might even come down to half that price, depending largely upon the character of the coal that is used. It need hardly be said that the whole problem consists in grinding the coal fine enough, and it is only within the last few years that mills for such purposes, generally spoken of as "colloidal mills," have been available as ordinary commercial appliances.

It may be emphasised here that the term "colloidal" is used in its strictly modern sense rather than in the sense in which the word was originally intended. Perhaps it would be more strictly correct to speak of the coal as a "suspensoid" rather than as a "colloid"; the latter term was invented by the late Thomas Graham in 1861, and first used in a remarkable paper in which he divided all substances into the two classes of crystalloids and colloids, but more recent research has shown that Graham's distinction is not strictly tenable, and to-day the term colloid is generally applied to any body in an extremely fine state of division. The degree of fineness varies to some extent with the substance, but is generally below 10 microns (1 micron = 0·00004in.). It follows from the established laws of physics that very minute particles when suspended in a fluid have a very small tendency to fall to the bottom of the containing vessel; such particles obey the law that was formulated a good many years ago by Stokes, the latest form of which, as quoted by Lunnon, is $v = 54 \cdot 5\, d^2 \frac{s-r}{\eta}$,† where v is the velocity of fall, d is the diameter of the particle, s and r are the specific gravities of the particle and the fluid respectively, η the viscosity of the fluid in dynes per square centimetre. All the above are expressed in C.G.S. units. It would follow from this law that the velocity of fall decreases the greater the viscosity of the fluid, and the smaller the diameter of the particle; but, nevertheless, there would always be a certain definite falling velocity in all cases. The above equation applies, however, strictly speaking, only to free-falling spheres, and the velocity of fall in the case of hindered falling, which must be the case of the mixture now under consideration, must necessarily be very much slower, though how much is really not yet properly known. Again, the crushing of coal does not produce spheres, but irregularly shaped particles, and in any particle, not a sphere, the proportion of surface to mass is necessarily greater than in the case of a sphere. This fact implies increased resistance to fall, and therefore again will slow up the particle, though to what extent is not definitely known as yet. All that we can definitely predicate to-day is that a collection of very numerous particles of crushed coal will fall at a very much slower rate than Stoke's formula would assign to a single spherical particle. The viscosity of oil varies within very wide limits and is largely effected by its temperature, s and r may without serious error be taken as averaging 1·25 and 0·9 respectively, so that obviously even if Stoke's law alone were effective, the rate of settlement must be extremely slow. There are, however, other forces operative. First of all, the oil may be taken as always containing truly colloidal bodies which will keep the particles of coal in suspension, whilst, furthermore, a number of minute particles will be animated by the Brownian movement, which keeps them in motion and prevents their cohering, this latter action being further intensified by the viscosity of the medium in which they are suspended, whilst the convection currents that must necessarily exist in a fluid mass may also help to keep the particles from settling. The facts reported by the authorities concerning the mixture on board the "Scythia" appear to bear out these theoretical considerations, seeing that it is stated that there was no sign of deposit in the tanks containing the fuel mixture.

We are further informed that there was no difficulty at all in pumping the fuel. Another advantage which was demonstrated was that the combustion was quite complete, and that there was no deposit on the decks of the vessel. The only drawback shown on the trip of the "Scythia" was that the jets of the burners had to be cleaned about twice as often as they would have been had oil alone been burnt. As some 150 tons of the oil-coal mixture were burnt on this trip of the "Scythia," the experiment was obviously conducted on a sufficiently large scale to be reasonably conclusive. It is, however, too early to say whether there would be any settlement of the coal out from the mixture on a much longer trip or whether the motion of the vessel had any effect, injurious or otherwise, on the behaviour of the mixture. Such points as these can only be decided by an experiment extending over a much longer period of time and under a wide variety of conditions, but it can fairly be claimed that the first experiment at any rate has proved to be a complete success and definitely encourages further investigation. Nevertheless, it is well to bear in mind that the experiment is still in quite the early stages, and it is impossible to-day to pronounce definitely upon its technical success or otherwise, whilst the economic value of the oil-coal mixture still remains to be demonstrated.

Obviously, the main interest to this country in the successful use of an oil-coal mixture instead of oil alone for firing boilers must lie in the possibilities thereby opened out of increasing our consumption of British coal, and correspondingly diminishing the consumption of oil, practically the whole of which has to be imported. The world's consumption of coal within the last few years has decreased, but not very greatly, whereas the British share in the supply of this coal has fallen off very severely indeed. There are, of course, a large number of causes that have contributed to this result, but among these causes must certainly be included the very obvious fact that oil is more and more taking the place of coal as a fuel. Take one instance (though a very pregnant one) only. In 1922 the proportion of coal-fired boilers to oil-fired boilers in sea-going vessels was more than 3 to 1, whilst to-day it is less than 2 to 1; and the tonnage of motor-driven vessels to-day is more than six times as much as it was ten years ago. This fact has affected this country particularly, because a few years ago we practically supplied all the world's bunkering coal, and it is obviously this trade which has suffered so severely by this competition of oil. If the oil-coal fuel proves to be a technical and economic success, part of this lost trade may well be recovered; it may, however, be surmised that an entirely different class of coal will reap the benefit.

In the past the coal preferred for steamship use was a very hard coal like the smokeless steam coal of South Wales, but, if an oil-coal mixture is to be used in the future, it appears probable that the softer coals, and those more easily and more cheaply ground to a fine powder will naturally be preferred. Other things being equal, it is quite obvious that a hard coal will occasion more wear and tear to the grinding appliance than will a soft coal, and will therefore on this account alone be dearer to grind, whilst it is highly probable that the power consumption of the grinding machine will be less and its output be greater, the softer the coal that it is called upon to grind. It is also evident that a coal low in ash will be selected, and here a cleaned small coal—preferably perhaps dry cleaned—will receive the preference. Another advantage of this mixed fuel would be that it will enable collieries to get rid satisfactorily of that portion of their output which is the most difficultly saleable to-day, namely, the very small coal, say, under ¼in. Whilst such small coal, if of coking quality, commands a reasonable market, the smalls of non-coking coal are very nearly unsaleable under present conditions, and this new method appears to promise a satisfactory means of disposing of this product. It is therefore from every point of view incumbent upon colliery owners to aid in bringing these experiments to a successful conclusion.

Apparently any class of coal may be used to make the mixture if sufficiently finely ground. As the mixture which the "Scythia" employed was made by the Wallsend Slipway and Engineering Company, Ltd., it was naturally North Country coal that was used, but this is no proof that coal from other coalfields would not give equally satisfactory results. The Institution of Mining Engineers has recently established a Committee for the express purpose of investigating all possible uses of coal and coal products, and it is practically certain that this new method of using coal will come within its purview. As has already been stated, the outlook is a distinctly promising one, and if this oil-coal fuel really proves successful, it assuredly gives good grounds for hoping that it may help this country to regain a portion, at any rate, of the coal export trade which it has lost of late years. The present grave condition of the coal industry should certainly encourage colliery engineers to put forth their utmost energies to make oil-coal fuel a complete success, both technical and economic.

* "Trans.," Inst. Min. Eng., Vol. LXXXII., 1931, page 230.

† "The Laws of Motion in a Fluid," by R. G. Lunnon. "Trans.," Inst. Min. Eng., Vol. LXXVII., 1928, page 68.

BOOKS OF REFERENCE.

South African Mining and Engineering Year Book, 1932; *Rhodesian Mining and Engineering Year Book*, 1932. London: Argus South African Newspapers, Ltd., 72–78, Fleet-street, E.C. 4. Price 21s. net and 12s. 6d. net.—These two books cover the complete mining and engineering industry of South Africa and Rhodesia. They contain particulars of Mining, Industrial and Financial Companies; Mines; Lists of Buyers; Consulting Engineers; Government Departments; Engineering Concerns; Overseas Manufacturers' Representatives and Buyers' Guides. Many illustrations and several excellent maps are given. All firms and individuals having interests in these countries will find the books of great interest and value.

Oil and Petroleum Year Book, 1932. By W. E. Skinner. London: Walter E. Skinner, 15, Dowgate-hill, E.C. 4. Price 7s. 6d. net.—The new volume gives full particulars of some 621 companies connected with the oil industry and allied trades throughout the world. Lists are given of the directors, secretaries, managers, &c., of the various companies, and the Trade Names section of the different kinds of oils will be found very useful. An interesting article by G. Clifford Carr, A.M.I. Mech. E., entitled "Modern Oilfield Development, Methods, and Equipment," is followed by a glossary of nearly 500 technical terms used in the industry. The book has been carefully revised and users will find the information it gives both dependable and easily found.

Kelly's Directory of the Merchants, Manufacturers and Shippers of the World, 1932. Two volumes. London: Kelly's Directories, Ltd., 186, Strand, W.C. 2. Price 64s. the two volumes.—These two volumes are so familiar to all business houses, and their value so well recognised that it is hardly necessary for us to say much about the new edition, except that it maintains the high standard of previous years. The extent of the labour involved in revising such a large work of reference is emphasised in the fact that it contains some one and a half million names, and deals with over 20,000 places. Scrupulous care, we are told, has been taken over the revision, and we feel sure that the new edition will be found as accurate and comprehensive as its predecessors.

Rubber Information. Edited by H. B. Cronshaw, B.A., &c. London: Leonard Hill, Ltd., 231, Strand, W.C. 2. Price 10s. net.—Those connected with the rubber industry will welcome the new edition of this reference book, which, with its wealth of information, will be found of equal, if not greater, value than the previous issue. In it are given the most important facts and figures relating to the industry in all its branches. The contents are arranged in the following order:—Index to Space Users; Advertisement Section; Alphabetical List of Firms; Classified List of Products and Equipment; Trade and Registered Names; Rubber Dictionary; Compounding Ingredients and other Rubber Chemicals; Rubber Trade Statistics; Plantation Companies. No efforts, we are informed by the publishers, have been spared to make the information contained accurate and comprehensive, and it is presented in such a form as to be readily of service.

A New Double-Acting Two-Stroke Oil Engine.

AN outstanding engine in recent oil engine practice, ashore and afloat, is the Burmeister and Wain double-acting two-stroke oil engine which forms the subject of to-day's Supplement. The engine is specially interesting on account of its invention having been made and its development carried out after a very careful analysis of the relative performances of various types of engines made possible by the published tests of the Marine Oil Engine Trials Committee. The first engine of the double-acting two-stroke type, see Fig. 1, was a six-cylinder 6000 B.H.P. unit built for the East Asiatic Company's single-screw motor ship "Amerika," which was put into service in December, 1929, and was followed almost a year later by a sister vessel, the "Europa." Last summer the Blue Funnel cargo liner "Stentor" was equipped with a similar engine, and four further marine installations, aggregating 40,000 B.H.P., were proceeded with, one of these engines being the

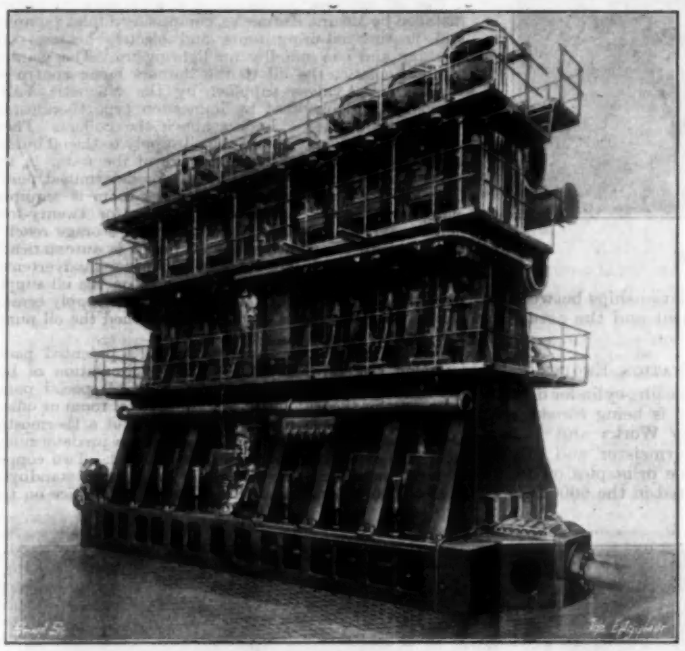


FIG. 1—6000 B.H.P. DOUBLE-ACTING TWO-STROKE ENGINE

5600 B.H.P. long-stroke engine, installed in the Danish motor ship "Peter Mærsk," which was commissioned in April this year. On the land side the greatest interest is being taken in the eight-cylinder 18,500 B.H.P. unit with a continuous maximum output of 22,000 B.H.P., which for the first time is illustrated herewith. It is being constructed at Burmeister and Wain's works for the Copenhagen Electric Power Station, and will be the largest stationary oil engine in the world. In what follows we give a description of the working principle of this double-acting two-stroke engine, with particulars of various installations and the results obtained.

WORKING PRINCIPLES AND CONSTRUCTIONAL DETAILS.

The general design of the engine has been influenced by the firm's long experience with the four-stroke engine in conjunction with a careful study of the scavenging problem. In order to obtain a positive scavenge of the straight-through type in both the top and the bottom ends of the cylinder a centrally placed scavenging belt is used with exhaust piston valves at either end of the cylinders, so that as soon as the scavenge ports are uncovered by the main piston the scavenge air flows upwards or downwards as required and leaves the cylinder through the ported exhaust piston valves. The scavenge air is furnished by a slow-speed electrically driven or chain-driven blower, to which later reference will be made.

Attention may be drawn to some special points in the design. The cylinder liners are in two parts, there being a short upper and a longer lower part in which the single row of scavenge ports is arranged. Each part of the liner is furnished with a flange for bolting to the cylinder cover. The liners and covers are secured to the engine framing by four staybolts which pass from the top cover down to the underside of the cross girder of the bed-plate. The jointing ends of the cylinder liners and covers only require to be made tight against the comparatively low pressure in the cylinder at the end of expansion and atmospheric pressure. As will be readily seen from the centre vertical section reproduced in the Supplement drawing, the air manifold is bolted to a jacket around the scavenge air belt, which extends around the lower cylinder liner and forms an effective cooling jacket. The liners are water cooled, there being a single cylindrical jacket bolted to the underside of the top cylinder cover and a similar arrangement at the bottom cover. The cylinder cover castings are almost alike for top and bottom. They consist of an inside cylindrical extension of the main liner with a domed end housed inside the square body of the cover casting. The bottom covers are bolted together in groups of three and cross braced by rods between the two groups; the top covers are separate. In addition to the flanges for the air starting and airless injection fuel valves each cover has a flange to which the water-jacketed exhaust piston valve and casing is attached. As shown in the drawings, the upper and lower piston valves are hollow castings with self-expanding Perlit piston rings and exhaust ports around the whole circumference. They are coupled to yokes connected with side rods and are furnished with telescopic pipes for internal oil cooling from the forced lubrication system. The drive for the exhaust piston valves is taken from a lay shaft which is arranged within the main crank case a little higher than the crank shaft, and is driven from it by a chain, an adjustable tightening gear being provided. By means of a connecting-rod and lever with the two side rods above referred to, the valves are given a reciprocating motion which uncovers the ports for the discharge of the exhaust gases. A diagram of the scavenge timing is reproduced in Fig. 2. Indicator cards of the main cylinder and light spring cards for the exhaust stroke show that the card from the piston valve is a very full one, with a high mean pressure, indicating that the piston valve develops a certain amount of useful work and represents an increase in engine horse-power of about 10 per cent. Full particulars of such indicator cards were given in Dr. H. H. Blache's paper on "The Marine Oil Engine," read before the Institution of Naval Architects in March, 1931, and reprinted in an abstracted form in THE ENGINEER of April 10th, 1931.

An interesting point with regard to the main pistons is that they are shorter than the pistons of most types of double-acting two-stroke engines, owing to the adoption of only one row of scavenge ports and the elimination of the exhaust ports. The pistons, which are of Perlit iron, are made in halves and are bolted around the flange of the piston-rods, the bottom half being extended so as to form a guiding surface. The pistons are oil cooled, the oil being admitted by means of telescopic pipes to the annular

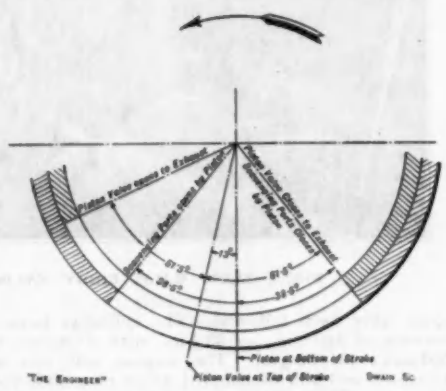


FIG. 2—SCAVENGING DIAGRAM

space between the piston-rod and piston, and led away through a central hole bored in the rod. In all the cylinder covers, both top and bottom, there are two automatic airless injection fuel valves arranged diametrically opposite to each other and so inclined that they spray towards the piston in a slightly curved fan-like form, which takes into account the ordered turbulence of the incoming combustion air imparted to it by the tangentially arranged scavenge ports. The engine is fitted with the usual marine pattern emergency governor controlling the fuel pumps, and all starting and manœuvring controls, which are very simple in character, are conveniently grouped at the centre of the engine. The general lay-out of scavenge air and exhaust manifolds is clearly indicated in the Supplement drawing, while the drawing to the right of the Supplement shows in detail the arrangement of the chain drives for both the lay shaft and the cam shaft.

Before proceeding to a description of the various installations a few words may be said with regard to the low-pressure rotary blowers, which form part of the Burmeister and Wain double-acting two-stroke plant. A section through one of these blowers is given in Fig. 3, while in Fig. 4 we reproduce a view of a typical blower with the casing opened up. The blower differs from other rotating blowers in the particular shape of the teeth, which are so designed

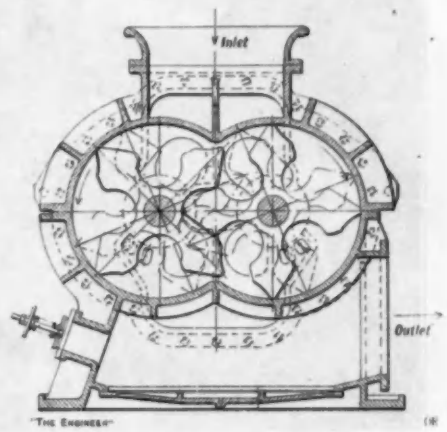


FIG. 3—SECTION THROUGH BLOWER

as to allow the air to be drawn in and discharged longitudinally through the rotors and their end surfaces, and not, as is more usual, from the teeth of the rotor. The turbo-blowers of this type used for the East Asiatic Company's ship are designed to run at 400 r.p.m. and have a rotor diameter of 700 mm., or 27 $\frac{9}{16}$ in. They are, we found during an inspection of the "Amerika's" machinery, remarkably quiet in operation, and they may either be directly driven by electric motor or chain driven from the main crank shaft.

THE "AMERIKA" AND "EUROPA" INSTALLATIONS.

The sister ships "Amerika" and "Europa," which were built and engined by Burmeister and Wain, Ltd., for the East Asiatic Company, are modern

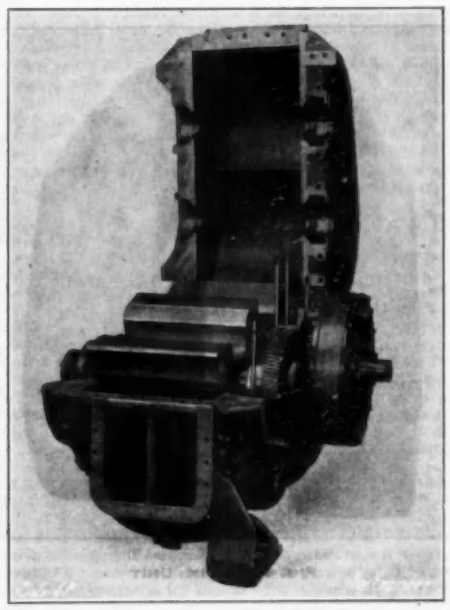


FIG. 4—BLOWER WITH COVER RAISED

cargo vessels with state-room accommodation for fifty-two passengers. They have a length overall of 484ft. 3in., a beam of 62ft., with a depth moulded of 40ft., and a loaded draught of 28ft. 3in. The dead-weight carrying capacity is 11,500 tons, with a gross tonnage of 10,000. The single set of main engines, illustrated in Fig. 1 and in the Supplement, has a cylinder bore of 620 mm., or 24$\frac{3}{8}$in., with a stroke of 1400 mm., or 55$\frac{1}{8}$in., with a rated output of 6000 B.H.P. at 95 r.p.m. at a mean indicated pressure of 95 lb. per square inch, corresponding to a ship's speed of 14 knots. When running at 7000 B.H.P. or 100 r.p.m., which output has been averaged over long distances, the corresponding ship's speed is 15$\frac{1}{2}$ knots. The fuel consumption is 0·37 lb. per B.H.P. hour.

The auxiliary plant comprises three auxiliary oil-electric generator sets, one of which is shown to the

right of our Supplement. These are two-stroke airless injection single-acting units with directly driven scavenge pumps. Each unit has a designed output of 600 B.H.P. at 300 r.p.m. and is coupled to a 365-kW 220-volt generator. The single-acting two-stroke type of engine has also been successfully applied for rail traction and for main propulsion. In addition to the usual service pumps there are two electrically driven air compressors for starting and manœuvring air, and a cross-tube oil-fired boiler for heating and domestic services. The actual weights of the machinery as given in the table below show that a low weight per horse-power has been attained,

	Metric tons.
Main engine	360
Oil-engined generators	75
Scavenging blowers and auxiliaries for oil engine	75
Reservoirs, silencers, spares and tools, auxiliaries for ship's use, &c., inventory, workshops, &c.	108
Shafting	100
Boiler plant	8
Electrical equipment for engine-room, floors, ladders, &c., piping	120
Total	846

giving a weight for the complete installation of 120 kilos. per B.H.P., or 51·5 kilos. per B.H.P. of the main engine, taking its output at 7000 B.H.P.

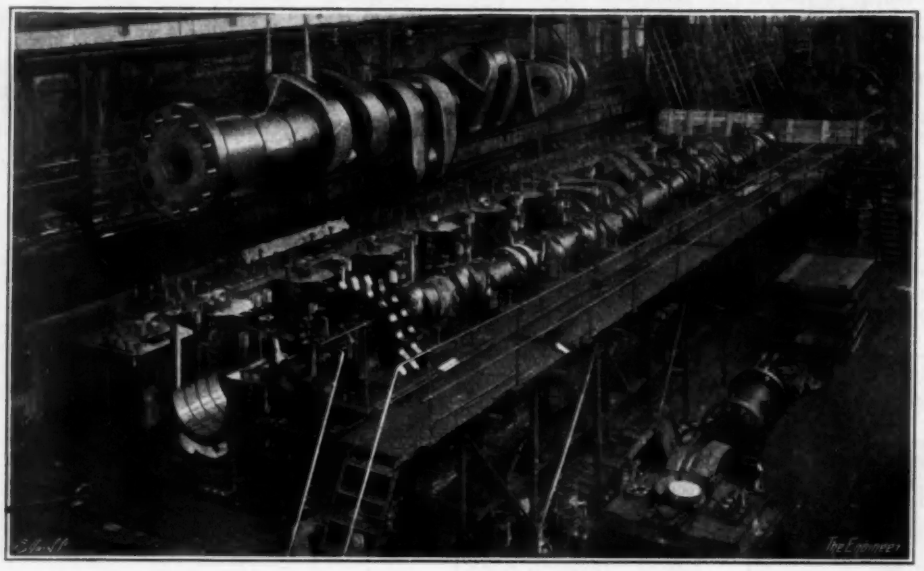


FIG. 5—BEDPLATE AND CRANKSHAFT OF 22,000 B.H.P. ENGINE

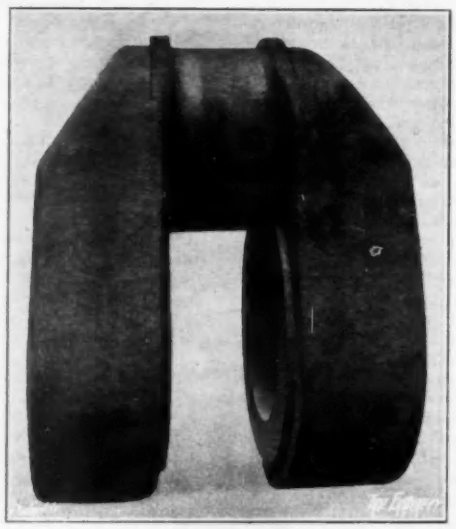


FIG. 6—CRANK UNIT

THE "STENTOR" INSTALLATION.

M.V. "Stentor" Results.

	First voyage, new engines.	Second voyage.
Distance	27,108	20,357
Time	88·75 days	64·83 days
Speed	12·73 knots	13·08 knots
I.H.P.	4392	4850
S.H.P.	3515	3930
R.p.m.	72·45	78·0
Slip*	2·4 per cent.	2·8 per cent.
Draught	21ft. 1in.	21ft. 10½in.
Displacement	9800 tons	10,210 tons
Oil per day	14·41 tons	15·91 tons
Oil per I.H.P. per hour	0·306 lb.	0·306 lb.
Oil per S.H.P. per hour	0·383 lb.	0·378 lb.
Admiralty coefficient	269	268
Theoretical oil coefficient	64,000	64,000
Oil coefficient	65,600	66,200
Efficiency	102·5 p.c.	103·4 p.c.

* Pitch of propeller was altered from 18ft. 3in. in the first voyage to 17ft. 6in. in the second voyage with new engines.

By the courtesy of Mr. Sterry B. Freeman, superintendent engineer of Alfred Holt and Co., we are able to give voyage results for the motor ship "Stentor" of the China Mutual Steam Navigation Company, Ltd. She was equipped with a similar engine to that above described during last summer, with chain-driven rotary scavenge blowers, and the engine is giving, we are informed, remarkably good results in service. The efficiencies of 102·5 and 103·4 per cent. referred to are the relationships between an assumed theoretical oil coefficient and the actual oil coefficient obtained in service.

22,000 B.H.P. POWER STATION ENGINE.

In Fig. 7 we give a view of the eight-cylinder double-acting two-stroke engine which is being constructed for the Copenhagen Electricity Works and is now approaching completion at Burmeister and Wain's works. In this engine the same principles of design and construction as those adopted in the 6000 B.H.P. engine have been followed. The cylinders have a diameter of 840 mm., or 33 1/16 in., with a stroke of 1500 mm., or 59 1/16 in. The engine will run at 115 r.p.m. and will be coupled direct to a 6000-volt alternator. The continuous maximum output of the unit is 22,000 B.H.P., or 15,000 kW with a normal daily load of 12,500 kW or 18,500 B.H.P. The set, which is the largest in the world, will be one of the centres of attraction during the sectional World Power Conference which is to be held in Scandinavia next year. The engravings Figs. 5 and 6 indicate clearly the construction of the bed-plate and the crank shaft, and attention may be called to the large sprocket wheels for the chain drive. The extension of the very original design of engine described to this large unit is a task on which Dr. H. H. Blache and his technical staff are to be warmly congratulated. The forthcoming tests of the engine will be watched with interest by both power station and marine engineers.

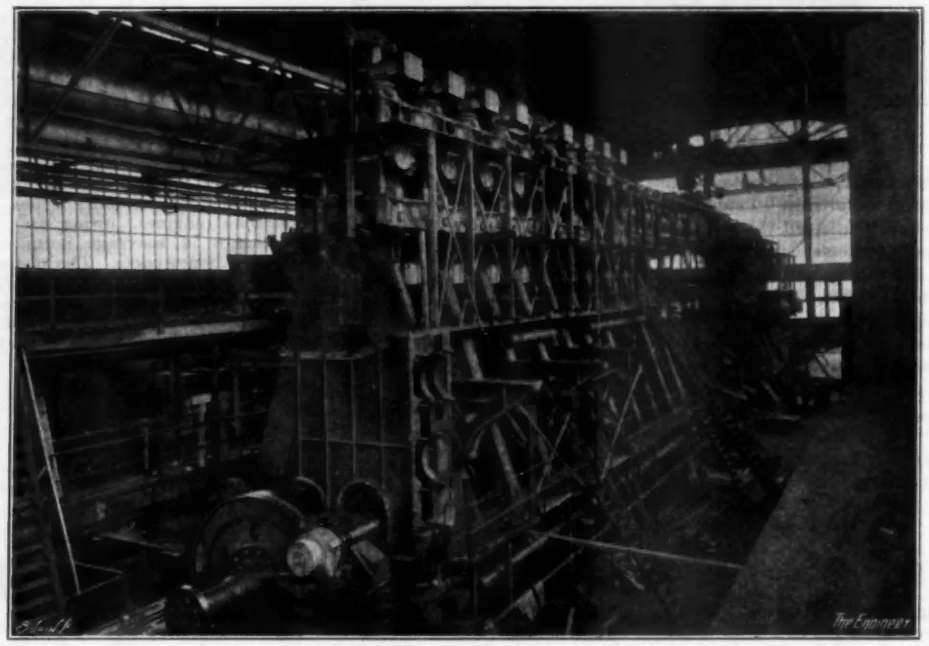


FIG. 7—22,000 B.H.P. EIGHT-CYLINDER ENGINE IN COURSE OF ERECTION

Martin's Bank Building, Liverpool.

THE new building for Martin's Bank headquarters at Liverpool, which is nearing completion, has a number of novel features in its heating and ventilating equipment, all of British origin and manufacture.

The lay-out of the boiler-house plant was the subject of special attention to procure a symmetrical arrangement. The walls and floor have an effective colour tiling scheme, and even the trench covers have been specially designed to accommodate tiles, which form a carpet fashion design for the floor. There is a metal ceiling with cork insulation, and the boilers have been fitted with planished steel fronts. In other parts of the boiler-house chromium-plated gauge plates have been fixed for distant temperature dial thermometers. Three boilers—two working and one standby—are installed, with two flue hot-water boilers supplied by H. and T. Danks (Netherton), Ltd. Each boiler is connected to a common subterranean horizontal flue, leading to a vertical brick-lined mild steel shaft 5ft. diameter and about 180ft. high, also supplied by Messrs. Danks. Each boiler is capable of raising 30,700 lb. of water per hour from 100 deg. to 270 deg. Fah. Three horizontal and two vertical hot-water storage cylinders are superimposed upon the boilers. Two vertical and two horizontal cylinders give sufficient thermal storage for a period of sixteen hours for the panel warming and hot water services throughout the building under normal conditions.

The oil fuel plant is composed of a pressure jet system installed by Messrs. Kermodes, comprising duplex pumping and heating oil-firing units and electric heaters—one working and one standby for lighting up. The plant is semi-automatic, the oil to the burners being controlled by magnetic valves supplied by the Magnetic Valve company, and operated by immersion type thermostats within the storage cylinders above the boilers. These valves automatically cut off the oil supply to the oil burner on the boiler when the temperature of the water in the storage cylinder above it reaches a predetermined point. Only one shift of labour in the boiler-room is required, eight hours' work providing a supply for twenty-four hours. When the whole of the required storage reaches the requisite temperature the oil pump is automatically put out of action. Should any oil burner inadvertently become extinguished, a magnetic valve on the oil supply to that particular burner closes and the oil supply ceases. Should all the burners become extinguished the oil pump motors automatically cease to function.

The building is warmed by Crittall's patented panel warming system. There is a forced circulation of hot water through approximately 25 miles of special panel tube, cast in the ceilings of each individual room or office. The temperature is regulated by means of a thermostat set to operate a magnetic valve when the predetermined temperature of the room has been reached. Two copper storage calorifiers—one working and one standby—each of 500 gallons capacity for hot water service on the gravity system, are fitted at a high level in the boiler-house. These calorifiers are of Messrs. Royles' make, and each is capable of raising 500 gallons of water from 50 deg. to 150 deg. Fah. The temperature of the water within the calorifiers is thermostatically controlled. Auxiliary top storage cylinders and calorifiers are fitted on the eighth and ninth floors for supplying hot water to the kitchen and dressing-rooms.

The ventilation equipment of the building is divided into six separate systems: (1) The main fresh air supply; (2) boiler-house fresh air supply; (3) strong room fresh air supply; (4) main extract systems; (5) lavatory extract systems; and (6) kitchen extract systems. The main fresh air plant comprises a centrifugal fan, a viscous type filter, ozone plant and air heating battery, the latter controlled by thermostats and magnetic valves. Warm, cleaned ozonised fresh air is delivered by ducts to the ground floor vestibule, bank working spaces, mezzanine floor, and the main banking hall. Regulation is obtained by dampers operated by Arens controls by means of a cold air by-pass duct. Tempered air is supplied

to the office storage spaces in the basement and sub-basement. Ozonised, filtered, cold, fresh air is supplied to the boiler-house by means of a centrifugal fan delivering to a system of metal ducts concealed by a suspended steel ceiling over the boiler-house working space. The void formed by this suspended ceiling is insulated by 6in. of granulated cork supplied by the Cork Insulation Company. The same fan also supplies air to the lift machinery room in the sub-basement.

The strong room fan is situated in the main fresh air fan chamber and is arranged to supply either cold or tempered fresh air to these rooms. The connecting ducts are of extra heavy gauge material, and are built in as part of the general strong room structure. The supply to each room is controlled by special valves, supplied by the Chatwood Safe Company, Ltd., of Shrewsbury. When the door of each strong room is opened the valve is operated and a cleansing breeze of fresh air enters.

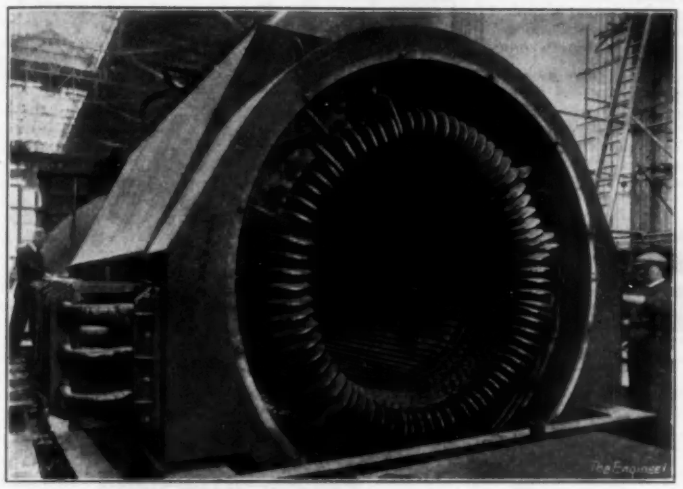
Natural extraction takes place from the boiler-house working space, transformer room and oil fuel store by means of metal ducts connecting to the space around the main boiler-house flue. The main extract system draws vitiated air from the office storage spaces, the main banking hall, working spaces on the mezzanine floor and various voucher stores on the first floor. A separate centrifugal fan situated on the roof extracts air from the kitchen and service corridor adjacent. The connecting ductwork is concealed by a suspended steel ceiling. The lavatory fan extracts vitiated air from the lavatories on the second, third, fourth, fifth, sixth, seventh and eighth floor. Extraction also takes place from the board room on the eighth floor. The total amount of air handled by the ventilating fans is 3,630,000 cubic feet of air per hour. The fans were supplied by James Keith and Blackman, the motors by Messrs. Bull, and the switchgear by Brookhirst Switchgear Ltd. The ozone plant was supplied by the Standard Ozone Company, and the heater battery by the Victoria Tube Company, Ltd. The filters are of the viscous type and were supplied by the Ozonair Company, Ltd. The whole of the warming, hot water service supplies and ventilating installation in the building was carried out by Richard Crittall and Co., Ltd.

Turbo-Alternator Stator Leads.

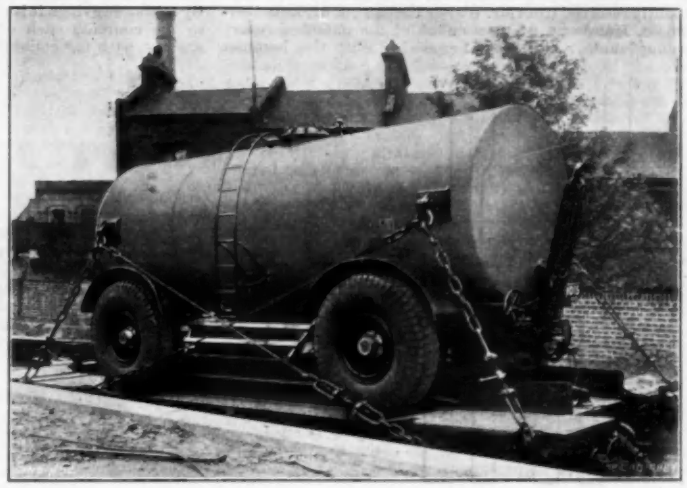
THE accompanying illustration shows the stator for one of the 67,200 kW turbo-alternators that have been installed in the London Power Company's new power station at Battersea. The complete machine, comprising the turbine and alternator, has been built by the British Thomson-Houston Company, and another set of the same capacity is being supplied by the Metropolitan-Vickers Electrical Company. The turbines are designed for a pressure of 570 lb. per square inch, and a temperature of 800 deg. Fah., whilst the alternators are wound for a pressure of 11,000 volts. An interesting feature of the stator shown is that the leads have been brought out at the side instead of at the bottom, in accordance with the usual practice. When horizontal steel members are used in the foundation, it is difficult to bring the leads out from the generator through the air duct walls on the way to the switch. As a rule it is necessary to provide current transformers in the delta or star connections for differential protection, and sometimes two sets of these transformers are required. Under these conditions the designer finds himself faced with the task of crowding all these transformers within the air duct, or of bringing six leads instead of three out through the air duct wall. The arrangement shown is, therefore, more convenient and has been adopted on a number of large B.T.H. sets.

Generally speaking, the generator is not so wide as the turbine with its piping and valves, and there is more free floor space next to the generator than there is adjacent to the turbine. Where necessary, it should be comparatively easy to provide a steel housing at the side of the generators to accommodate all the current transformers and delta or star bus-bars, thus eliminating crowding and complications from the air ducts and facilitating inspection. An article appearing in *B.T.H. Activities* on "Turbo-Alternator Stator Leads" suggests that perhaps it would be possible to go a step further and incorporate current transformers in the generators themselves. The idea of fixing terminals to the side of electrical machines is not, of course, new, as most small motors and slow-speed alternators have their leads brought out to a terminal board fixed in that position, but in the case of turbo-alternators it has been the general practice to take the leads down through the bottom half of the end shield at the exciter end of the machine.

Hitherto difficulties with stator leads have been somewhat mitigated on B.T.H. machines by other methods. With single circuit windings the high-tension leads have been led out into the incoming air space at the exciter end of the machine, whilst the corresponding neutral leads were brought out to the incoming air space at the turbine end. In the case of large machines with windings composed of two parallel circuits, the whole of the connections and terminals associated with one circuit were brought out into the air duct at one end of the generator, whilst those associated with the other winding were led into the duct at the opposite end. One neutral point was brought out for each set of windings, and the machine was protected in accordance with the split conductor method. This practice was first varied by bringing the leads out sideways through the endshields into junction boxes laid in a trench at the side of the machine, and from these boxes cables were taken to the switchgear. Similarly, on the other side of the stator, the neutral leads were brought out. In later machines of large capacity the connections between the machine and switchgear have been in the form of taped copper strip, and the idea of bringing out the leads at the side of the stator has been further developed by providing an enclosure for the leads and by bringing out phase leads from both ends of the alternator on one side and the neutral leads from both ends on the opposite side.



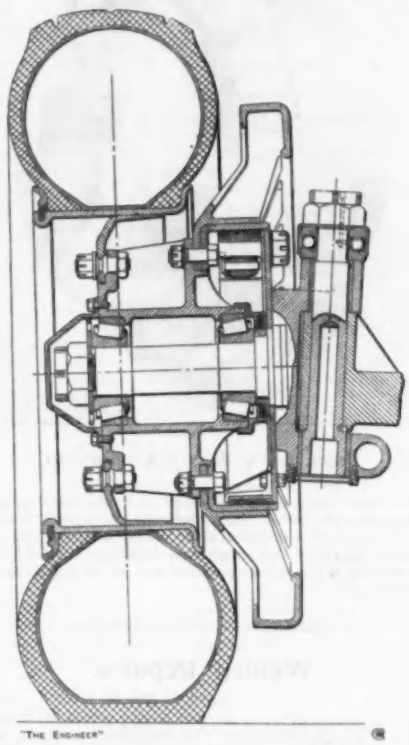
STATOR FOR 67,200-kW TURBO-ALTERNATOR



MILK TANK TRAILER ON RAILWAY TRUCK

Mobile Milk Tank Trailers.

THE "Dyson" system of milk transport was first used in this country in October last, when the Co-operative Wholesale Society, Ltd., placed in service two "Dyson" milk tank trailers operating between Bruton, Somerset, and London. This system, developed by R. A. Dyson and Co., Ltd., of London and Liverpool, consists in having a special tank trailer which is filled at the local dairy, then taken by road to a railway depot, where the trailer is run direct on to a railway truck, which takes it to the main railway depot nearest to the consuming area. The trailer can then be run off the railway truck and taken by road to the bottling depot. The C.W.S. service makes use of two "Dyson" six-wheeled trailers, each fitted with a 2000-gallon Butler glass-lined tank. A further trailer has now been placed in use. The United Dairies have also recently adopted the "Dyson" system and are considerably extending its scope. In order to meet the company's requirements it was necessary for the trailers to be mounted on giant low-pressure pneumatic tires, and Messrs. Dyson therefore introduced a new patented type of drum wheel.



SECTION OF ROAD AND DRUM WHEELS

For safe transit it is necessary for the trailer to be guided into an exactly central position on the truck and then to be locked firmly in place. The trucks which carry the trailers form part of a passenger train and consequently elaborate precautions must be taken to avoid any possibility of mishap. It is in particular necessary to take the weight of the trailer off the tires during transit. The drum wheel system enables this step to be taken very simply and at the same time offers an easy method of automatically guiding the trailer into its proper position on the truck. The drum wheels are made of cast steel and are bolted to the hubs and act as holders for the brake drums. They engage with guides on the railway truck, consisting of a guiding plate and an elevating rail which rises up underneath the drum wheel and as the trailer is pulled into position gradually takes the weight off the tires until the whole weight of the trailer is supported on the drum wheels and the elevating rails. In order to minimise the amount of rise in the lifting rails the floorboards of the truck are cut away so as to form a well. As the trailer is pulled into position the drum wheels come to rest on the elevating rails and the weight is taken off the tires without the trailer as a whole being raised at all.

The United Dairies trailers will be operated on both the Southern and Great Western railways, and in each case the railway company has built special trucks to accommodate the trailers. If a number of trailers have to be unloaded at one depot it may be necessary to haul the trailers from one truck to another and accordingly the trucks are fitted with hinged flap plates at diagonally opposite corners. These plates, when lowered, bridge the gaps over the buffers. In order to haul the trailers on to them pulleys are fitted on the trucks. A wire cable passing through one of these pulleys is fixed at one end to a coupler on the trailer axle and at the other end to the power unit which hauled the trailer to the railway depot. Wheel bars are fixed against the drum wheel to lock the trailer in position. Holding-down chains or cables are also fitted as an extra precaution. The drum wheels are arranged so that in the event of a puncture occurring whilst the trailer is on the road the drum wheels will temporarily carry the load.

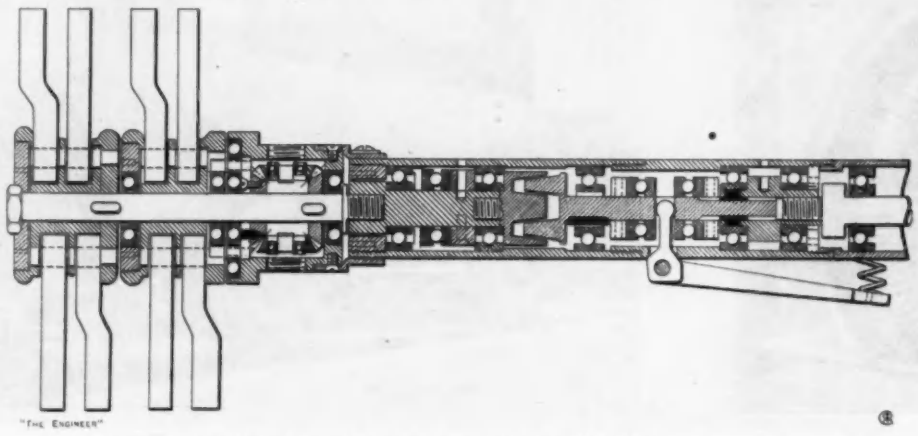
The trailers each carry 2000 gallons of milk, and as the laden weight of the trailer must not legally exceed 13 tons it has been necessary to reduce the tare weight of the trailer to approximately 4 tons. The trailers are of the frameless type, but two channels are fitted at each end which combine the function of carrying the springs and the channel boxes to which the draught gear is fitted. The tanks were made by Thompson Bros. (Bilston), Ltd., and are of Firth's "Staybrite" stainless steel, $\frac{1}{4}$in. thick. They are insulated by means of six layers of "Alfol" and covered with 18-gauge aluminium.

All four wheels of the trailer are fitted with "Dyson" double-acting self-energising brake gear which can be operated by pressing the draw-bar downwards. The gear can also be operated by means of a brake wire from the power unit. Brake screw operating gear is also fitted at both ends. The brakes are 17in. in diameter and work in cast steel drums pressed into the drum wheels.

If the vehicle were transported resting on its springs severe stresses would be set up in the holding-down chains as a result of the resonance between the springs of the railway truck and the springs of the trailer. To overcome this source of trouble deadening jacks are fitted to the trailer springs. These jacks are of the usual block thread pattern, $\frac{1}{4}$in. pitch, and are fitted with swivelling foot. They are not designed to carry the load, but are merely meant to steady it. They may, however, be momentarily highly stressed by bumping when the truck is crossing points, &c., and are sufficiently strongly supported to meet this contingency. It was necessary to design the hubs and the axles of the wheels for two separate load lines: (*a*) one passing through the centre of the tire, which is used when the vehicle is on the road; and (*b*) one passing through the centre of the drum wheel when the trailer is on the railway truck. To withstand these unusual conditions Timken taper roller bearings were employed. The high stresses produced by the unusually long overhang of the main load line necessitate the use of massive stubs, the pins of which are fitted with Hoffmann thrust bearings.

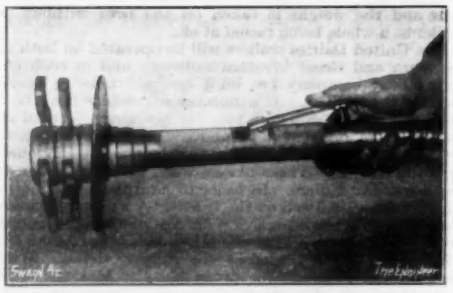
A New Hand-Controlled Rotary Scaling Hammer.

UP to the present the extended use of rotary scaling hammers has been somewhat retarded by the difficulty experienced in their operation. In most designs the hammer elements are arranged to revolve in the one direction, with the result that the tool when in operation tends to run on the surface of the work and must be held up to the plate. Nevertheless, with a good design of hammer it is possible to remove rust from a metallic surface at the rate of about 400 square feet in eight hours, compared with, say, 32 square feet possible with hand scaling. We have recently received from Mr. Walter Kirkam, of 82, Lubeckerstrasse, Hamburg, 24, particulars of the patented rotary scaling hammer illustrated herewith. With this hammer



HAND-CONTROLLED ROTARY SCALING HAMMER

it is claimed that a practised operator can in eight hours remove heavy rust from 1600 to 2100 square feet of surface. The hammer differs from other designs, in that the rows of elements revolve in opposite directions. In the small hammer illustrated below there are six elements, while in the larger size twelve are employed, which deliver 36,000 blows per minute, removing the rust very equally. The opposed motion of the adjoining series of hammer elements does away with the running above referred to, as the pressure is thereby equalised, which enables the tool to be worked with one hand. The possibility of damage to edges and gaps in plates is avoided and it becomes possible to work with the tool on the thinnest of sheets without damage being done to the material. The heads of rivets and the spaces between the rivets, also the inequalities and pores caused by corrosion, are cleaned as easily as in the



SCALING HAMMER

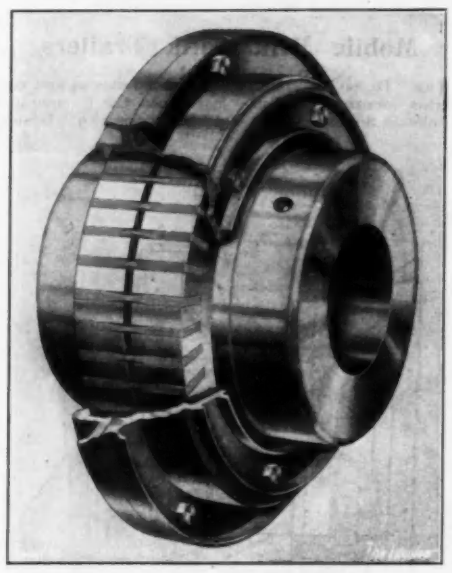
case of flat plates. The same applies to boiler plates, corrugated furnaces, and pipes. The opposed motions of the hammer elements assist in cleaning thoroughly the surface to which the tool is applied.

The control of the tool is effected by a small lever pressed by the thumb, which places the hammer in and out of operation and saves the necessity of switching off the driving motor. The patented coupling, as will be seen from the drawing, consists of two concentrically arranged double-cone or taper rings which fit accurately within each other and are kept together by the pressure exerted on the lever. During the moment of establishing contact the slight resistance sets up a layer of compressed air between the surfaces, which has the effect of freeing the surfaces in contact as soon as the pressure on the lever is released. The male part of the coupling is fixed to the end of the flexible shaft, which is carried in ball bearings in the normal manner. This part of the coupling is pressed into the female part by means of the spherical end of the bell crank thumb-operated lever, the thrust being taken by ball thrust bearings. When the lever is pressed down the drive is transmitted through the cone coupling to the hammers, the reverse motion for the inside set of hammers being obtained from the differential arrangement of gear wheels shown. The outside sets of hammers runs in the direction of the driving shaft and the inside sets in the opposite direction.

The coupling above described is suitable, it is claimed, for a wide range of machines and instruments, including motor cars and braking devices. It may be remarked that in the case of the coupling for the scaling hammer it has been found possible to control the power from a 14 B.H.P. motor quite easily. The advantage of the coupling would appear to consist in its very soft starting and stopping characteristics without endwise movement, thereby enabling a large friction surface to be accommodated in a very small space. This can be accomplished by introducing more than two concentric rings or by lengthening the tapered parts. The coupling has been shown, we are informed, to operate in a reliable manner under all working conditions.

A New Flexible Coupling.

IN the accompanying engraving we illustrate the "Steel-Shaw" flexible coupling made by Steele and Cowlishaw, of Stoke-on-Trent. It comprises two cast steel hubs, one keyed to each of the two shafts—the driving and the driven. Grooves are cut in the periphery of each hub and the actual coupling of the two parts is provided by specially shaped keys of spring steel that fit into the grooves. Each spring is so shaped that its ends are a close sliding fit in the grooves, while at its centre it has a waist substantially less in thickness than the ends. The sides of each spring are shaped to a double parabolic curve. By so shaping them it is claimed that when a load is applied to the coupling each of the springs bends or "gives" slightly, with the consequence that a greater length comes into contact with the side of the grooves and the "span" between the bearing points in each half coupling is decreased. If the coupling is subjected to a very severe overload the curved surfaces of the springs press upon the whole length of the sides of the slots and consequently the springs come into direct shear. This stress they are well able to bear, since the breaking load would be approximately fifteen times the heaviest working load. Flexibility, it is claimed, is retained even when serious misalignment of the two shafts is present. The coupling, as indicated in the engraving, is completely enclosed by a cover. All the parts are made of metal, the half couplings being steel and the outer casing iron. For very high speeds the casing also is made of steel. If it is required that the two shafts shall be disconnected, the operation can be rapidly performed without end movement. The halves



STEEL-SHAW FLEXIBLE COUPLING

of the outer casing are unbolted and slid back and the springs are withdrawn. A special lubricant is packed within the coupling to eliminate wear as far as possible. The makers claim that this coupling is smaller in total diameter to transmit a given torque than any other coupling of a similar type.

Welded Repairs.

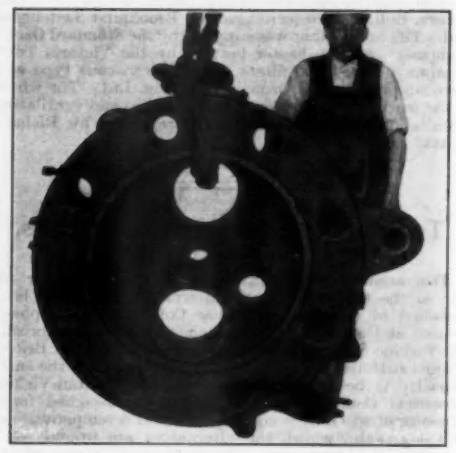
IN the course of a recent visit to the works of Barimar, Ltd., of 10, Poland-street, Oxford-street, London, W. 1, we saw a number of very interesting jobs in the way of repairing broken machinery by welding with both acetylene and electricity. It seemed strange to find a highly organised and quite extensive works in this neighbourhood, but, as was pointed out to us, it is a very central position and enables work to be executed and quickly dispatched over a wide area. The extent of that area may be gauged by the fact that we saw the frame of a large drilling machine, which had been sent from Manchester for repair. It speaks well for the reputation of the firm that a casting weighing some tons should be sent such a distance for repair. It is not, however, always necessary to send the job to the Barimar works, as the company has portable welding outfits which can be sent out.

An interesting example of the work done is that illustrated, and comprises two oil engine cylinder heads from a Norwegian motor ship lying at London docks. The cracks in the cylinder heads were in the centre, between the valve cage housings and at the base of the air starting ports—the latter is, by the way, a most inaccessible part to weld. In carrying out these repairs the welders worked in relays to prevent distortion by lowering of temperature. The castings, which weighed nearly 2 tons each,

CRACKED CYLINDER HEAD

were tested to 500 lb. per square inch in the presence of the Surveyor of the Bureau Veritas, and were stamped by him. An important matter in connection with a repair such as this is that the company has an extensive machine shop and can consequently finish a job right up to the stage where it is ready to be put to work again. The assurance that the repair is sound is enhanced by the fact that the laboratory at the works is equipped with an X-ray apparatus, with which photographs of the interiors of welded joints can be taken.

The work done at the factory is not confined merely to mending cracks and fractures, and we saw several examples of what might be described as rebuilding work. That is



REPAIRED CYLINDER HEAD

to say, making good, pieces which had been totally lost. Take, for instance, the case of a four-cylinder petrol engine, one cylinder of which had completely gone, carrying with it part of the crank case. A new cylinder had been cast, welded in place, and the whole made good and serviceable for a less cost than that of a new casting.

Many non-ferrous metals may be treated in the same manner as iron and steel. A very interesting demonstration was given us of the possibility of welding Elektron metal. This metal, which is used largely in aeroplane work, is an alloy, principally of magnesium. If it is kept too long at a temperature above that of fusion, it starts to burn, like the familiar magnesium ribbon, and the whole casting is then rapidly consumed. Barimar, Ltd., can however, make a weld in this metal, which will hold after the adjacent parent metal has been broken.

EASEMENTS granted to power companies for the construction of dams and impounding of water are subject to taxation, according to a ruling given by the Attorney-General's Department of the State of Texas. The permit itself is but a license, according to the decision, but if possession is taken of the river bed, dams built, and water impounded, the exercise of these rights create an estate in the land.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midsummer Quarterly Meeting.

THE Midsummer quarterly meeting of the Midland iron trade was held in Birmingham to-day—Thursday—and although there was a large attendance of producers and consumers from all parts of the country, there was but a faltering trade movement, transactions not being far in advance of those customary at an ordinary weekly gathering. There was the usual review of industrial conditions and trade prospects, and it was the latter category that proved the most interesting and agreeable. There was an undoubted, though admittedly qualified, optimism in the manner of industrialists speaking of the future, and there are genuine beliefs that trade will mend from now on. Much praise is given to the Government for its handling of recent difficult matters, and it is asserted that at long last industry is receiving from the Government of the country some help in its struggle to reassert itself in the home and world markets. The future for Midland industries is held to be brighter and iron and steelmasters, engineers, manufacturers, and merchants who gathered at the Midsummer meeting were decidedly more hopeful than has been the case at any gathering of a similar character this year. There is a belief that enterprise will be rewarded and that the future has better business in store than the past few years have provided. The new quarter is therefore entered upon with renewed hope of an increase in activity in the industries of this area, and of more remunerative production than during the past quarter.

Staffordshire Bars.

Staffordshire ironmasters engaged upon the production of finished iron are looking for improvement in demand in the near future, but they report the past quarter as having been less productive than the one preceeding it, which, in turn, showed no improvement upon its predecessor. Business has been of a hand-to-mouth character, orders having come in week by week for small tonnages. In the marked bar department there has been, and is at date, more movement than in the other branches of the industry, but the quietude in the engineering industries in this area has a detrimental effect upon the activity in Staffordshire ironworks. Makers of best grade bars maintained their selling price throughout the quarter at £12 per ton, and negotiations to-day were on the same basis. In Crown and common bar circles fierce competition for a small amount of available business has brought about some fall in values. Crown bars, which in April were quoted £9 5s. to as high as £10 7s. 6d., sold to-day at £9 to £9 15s., while common bars which were £8 to £8 10s. are now £7 15s. to £8. If the output at the mills had improved, it might not have been so bad, but unfortunately, this cannot be said to have been the case. Strip mills were fairly well supported during the quarter, and makers at the midsummer meeting were able to command the same figure for their production as ruled at the last quarterly gathering, namely, £10 10s. per ton. There was no reinvigoration of demand discernible in any branch of the industry, as a result of to-day's gathering of producers and consumers.

Pig Iron.

Blast-furnacemen in the Midlands have to some extent renewed their order books, a number of consumers having recently entered into fresh contracts which extend over the current quarter. The trouble is not exactly a shortage of contracts, however, but the specifications against them week by week, which are unsatisfactory. Orders in many cases extend over a period longer than anticipated when placed, while smelters, not knowing their actual requirements, produce more than is wanted, and as a result have to put a good deal of material into stock. It is thought that the material in blast-furnacemen's yards will gradually be lessened as the quarter advances, and any trade revival will have to absorb these stocks of iron before there can be any thought of bringing into operation additional Midland furnaces. There was no great movement in raw iron market circles at the quarterly meeting to-day. Selling prices stand where they were at the opening of the year, the Central Pig Iron Producers' Association, which is responsible for the fixing of the minimum selling basis, having reaffirmed existing prices month after month. The Association's periodic review of the situation as affecting the industry has evidently provided no ground for supposing that they might be successful in securing better terms for their production. Black Country foundries and forges are not very active, and their material requirements are light. The pipe foundries continue to absorb a large proportion of the iron produced in Derbyshire, while a not inconsiderable tonnage of Northamptonshire iron is being disposed of out of this district. For sale in this area, the fixed prices of pig iron are:—Northamptonshire: No. 3 foundry, £3 2s. 6d.; forge, £2 17s. 6d. Derbyshire: No. 3 foundry, £3 6s.; forge, £3 1s. Values of hematite in this market tend downwards. East Coast hematite costs about £3 7s. 6d. for mixed numbers. There is very little trade passing, however. It is reported this week that the Central Pig Iron Producers' Association has conceded improved terms to merchants as a result of long negotiations with the Iron Merchants' Association. The commission is advanced from 1½ to 2 per cent.

Steel.

There were no developments of note in the steel section at the quarterly meeting. An advance in demand for special steels has recently been made, but the call for heavy material is meagre, and unchanged as regards general volume. Complaints are general regarding the scarcity of contracts for structural engineering, and this dullness reacts on the steel works. Specifications for prompt rolling are eagerly sought in order that mills shall be kept at work with as few breaks as possible. Prices of heavy steel are unchanged at the rates specified by the Steel Association. These prices are unaltered from where they stood at the previous quarterly gathering. Angles are £8 7s. 6d., less 15s. rebate to users confining themselves to British material; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge, and tank plates, £8 17s. 6d., less 15s. Boiler plates, prices of which are not subject to control, have fallen slightly during the past quarter, the present quotation of £8 7s. 6d. to £8 10s. comparing with a firm figure of £8 10s. in April. Small steel bars of all-British material at £7 per ton are 5s. cheaper than they were at the opening of the quarter, and billet values have fallen by about half a crown per ton, being now named £4 17s. 6d. to £5 7s. 6d. Re-rolled bars continue to be worth £6 7s. 6d. upwards, and Staffordshire hoops £9 10s.

Galvanised Sheets.

Local producers of galvanised sheets have not had a satisfactory quarter, the mills having been generally short of business. Selling prices have been reduced in an effort to stimulate buying, but with little success. Twenty-four gauge galvanised corrugated sheets are half a crown to 5s. per ton cheaper than they were at the spring quarterly meeting, to-day's quotations of £9 5s. to £9 7s. 6d. comparing with the firm basis of £9 10s. ruling three months ago. There has been some broadening of inquiry during the past week, and orders have come in on a slightly better scale from South America, but the increase in business is not sufficient to warrant higher selling rates. The overseas demand as a whole is much below normal, but the call from users at home keeps up well. There were few pointers at to-day's gathering towards a lasting accession of business, and millowners will have to be content to await the development of demand which some confidently hope for.

Cannock Coal Distillation Plant.

An event of outstanding importance to the Cannock Chase coalfield is the production by the Leacroft coal distillation plant at Cannock of petrol, oil, and smokeless fuel. For three years past, experiments have been in progress, and the success which is now claimed may well mean a new era to the local coalfield. The coal which is being used at the Leacroft works is the finest kind of slack, which has comparatively small market value for other purposes. This pulverised fuel is stated to be producing 65 per cent. petrol, as well as a good clear quality oil which has already been used in oil engines by one of the largest omnibus undertakings in the country. In addition, there is a smokeless fuel which, it is said, can be used in any place where ordinary coal can be burned. Various grades of coal from several coalfields have been experimented with, and it is hoped that it will be possible to make full use of supplies from local collieries.

Glassworkers from Abroad.

The quarterly report of the National Flint Glass Makers' Society contains a protest against the importation of Continental glass makers to fill vacancies in English glassworks. Alderman W. Bradford, of Dudley, the general secretary of the Society, in an interview, stated that in reply to a letter of protest which he sent on behalf of the Society to the President of the Board of Trade, he had received an intimation that his complaint had been passed on to the Minister of Labour, who now controlled the admission of alien workpeople. "It seems to us," said Alderman Bradford, "not only grossly unfair, but absolutely ridiculous that while the Government is imposing tariffs to help to find employment for the British worker, foreigners are being brought in to do the work. If Englishmen could not do the work we should not complain, but British glassmakers have been working on the Continental system for a number of years now, and are as capable as any foreigner who could be brought here." An endeavour has been made, Alderman Bradford stated, to obtain increased tariff protection for the glass trade. In 1931 there was a 50 per cent. tariff in the domestic and illuminating section, but this was reduced by the Tariff Commission to 20 per cent.

Famous Engineer and Scientist.

Sir Richard Threlfall, G.B.E., F.R.S., the engineer and scientist of international celebrity, passed away in his seventieth year at Edgbaston on the 10th inst. Sir Richard was by profession a consulting engineer, but his deep scientific knowledge and inventive genious were placed at the disposal of his country in a variety of capacities. He was a director of Albright and Wilson, chemical manufacturers, of Oldbury, to the time of his death. In 1905 he was elected Chairman of the Royal Commission on the Spontaneous Combustion of Coal in Ships. During the war Sir Richard's accomplishments in the realms of chemistry and physics were an invaluable asset to the country, and the authorities made use of his services in many directions. He was a member of the Advisory Committee of the Department of Scientific and Industrial Research, the Trench Warfare Committee, and the Chemical Warfare Committee. He achieved distinction for his work in connection with naval and military smoke screens, originating the use of white phosphorus for this purpose. He also invented the anti-aircraft bullet which bears his name. He was created a Knight of the British Empire in 1917, and was promoted to the Grand Cross of the Order in 1927. Sir Richard was formerly Chairman of the Board of Fuel Research and at the time of his death was Chairman of the Chemistry Co-ordination Board.

The Late Mr. Henry Huggins.

It is with regret that I have to record the death on the 8th inst. of Mr. Henry Huggins, who for fifty years was connected with the tube industry in the Midlands. Mr. Huggins was seventy-two years of age, and was well known and highly esteemed in the Birmingham area. His father, as the founder of the Britannia Tube Company, was one of the pioneers of the tube industry. On his father's death the business passed into the hands of Mr. Henry Huggins and his brother, Mr. Frederick Huggins. In 1930 the firm was amalgamated with Tube Investments, Ltd., to the board of which Mr. Henry Huggins was appointed. He retired in the following year on account of illness. Mr. Huggins and his brother founded the Simplex Conduits Company, of which he was chairman for many years. He was also Chairman for a long period of the Brass Cased Tube Association.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Newcomers.

A GOOD many people will be disposed to agree with Lord Derby, who, when he presided at the first annual meeting of the Lancashire Industrial Development Council, expressed satisfaction at the results of the first year's work of the Council. At odd intervals during the past twelve months have come the announcements of the establishment, mainly by foreign interests, of new industries in the county, but the imposing list of such new enterprises contained in the annual report of the Council will cause general surprise, whilst the prospect of further additions is held out by the fact that foreign interest in Lancashire as a potential site for branch factories is still in evidence. Primarily, the enterprises are concerned with one or other section of the textile industries, developments of an engineering nature being confined to the manufacture in a Salford works on mass production lines of special hand tools which were formerly imported from the Continent, and the manufacture of radio and electrical accessories at works in Openshaw and Collyhurst, Manchester. It is, however, reasonable to assume that Lancashire engineers will derive some benefit in the long run from most of the industries that have been established. In the meantime, progress is being made with the works of British Copper Refiners, Ltd., at Prescot, for the manufacture of high conductivity copper, and it is expected that when completed direct employment will be provided for something like 600 men.

A Sunday Visit.

The unusual if not novel course of throwing open the works for inspection by their employees and relatives and friends of their employees was decided upon by the directors of Mirrlees, Bickerton and Day, Ltd., engineers, of Bramhall Moor-lane, Stockport, and something like 1000 visitors all told took advantage of the visit last Sunday, the interested people including many employees who were enabled to take a somewhat broader view of the works activities than would usually fall to their lot. Judging from the mere numbers of the visitors it would appear to be an experiment that could be tried with success by other engineering firms.

The Oil-engined Omnibus.

Mr. R. Stuart Pilcher, general manager of the Manchester Corporation Transport Department, who, with members of the city's Transport Committee, attended the International Transport Congress at The Hague, and afterwards spent a week in Germany, has expressed the opinion that the use of oil engines on the Continent is being restricted by lack of capital. Outside London, Manchester is probably the biggest user of heavy-oil-engined omnibuses in the country, and Mr. Pilcher, it is understood, was hopeful of securing some useful information from Continental users which would help to solve the problem of the emission of black exhaust gases which are an objectionable feature of most of the heavy-oil-consuming omnibuses operating in the Manchester district. One of the principal routes in the area runs through Stretford, and the local authorities there have made strong protests upon the matter.

The Oil-coal Experiments.

Possible developments arising from the Cunard Steamship Company's experiments on the "Scythia" with the new oil-coal fuel are being watched with interest in Lancashire, for any serious adoption of the process would probably confer substantial benefit upon Manchester as an oil port and also upon the Lancsahire coalfield, locally produced coal having been found to be very suitable for the new colloidal process.

Non-ferrous Metals.

After the general advance in non-ferrous metals recorded a week ago, a certain amount of reaction due to profit-taking by speculative operators was to be expected. This has occurred in all sections of the market with the exception of tin. In the latter case, there has been a further advance of nearly 30s. per ton on balance, although the highest point touched during the week has not been maintained. Rather more interest in the metal has been displayed by actual users. Warehouse stocks held in this country have declined again, and some improvement in the general statistical situation is anticipated. On the whole, there has been a fair movement in the copper section without, however, any actual expansion of buying interest by consumers either in Europe or the United States. Standard brands of copper are about 10s. lower than the prices current a week ago. Lead has reacted to the extent of about 5s. per ton, but the undertone in this section appears to be reasonably firm, and, if anything, the demand has been better. More interest has also been reported in the case of spelter, but prices are lower by about 2s. 6d. per ton on balance.

Iron and Steel.

In the iron and steel markets the generally dull conditions have been intensified by holiday influences and little improvement is looked for during the next month or two. The movement of foundry iron is being seriously interfered with by the heavy and cheap supplies of scrap, which have led to a much increased consumption in many foundries relative to that of pig iron. The current range of prices for scrap material is 32s. 6d. to 37s. 6d. per ton, delivered to buyers' works, the higher figure being

for good quality textile machinery. Odd replacement contracts extending over the next few months continue to be reported by foundry iron makers, but, generally speaking, there is little disposition to allow commitments to extend beyond users' own order books. For delivery equal to Manchester, Staffordshire, Derbyshire, and Cleveland No. 3 iron are all quoted on the basis of 67s. per ton, with Northants at 65s. 6d., Derbyshire forge at 62s., Scottish foundry iron at about 84s. 6d., and West Coast hematite at 81s. Inquiry for manufactured iron is on a slow scale, but prices are maintained at £9 15s. per ton for Lancashire Crown bars and £10 5s. for best quality material. Business in the steel market is virtually confined to current needs, and the demand from the heavy using industries in the Lancashire district is disappointing still. Interest in special alloy steels is quieter again, and there is only a moderate demand about for both iron and steel forgings. Acid and basic boiler plates are quoted at from £8 10s. to £8 12s. 6d. per ton, according to quantity, small re-rolled bars at from £6 15s. to £7, sections at £8 7s. 6d., joists at £8 15s., general plates at £8 17s. 6d., and large diameter bars at £9 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

There is no change to note in the hematite pig iron market. The home demand, which is still on the light side, is steady, and fortunately, at Barrow, the steel departments are taking the greater proportion of output. At certain works stocks are coming down slowly. It practically amounts to the fact that makers are waiting for the first signs of an improvement which they are sure will come, and which they are also sure will affect the local market. The Continental demand continues to be very low, but it is hoped that recent international agreements will have an improving effect upon trade abroad and thus start shipments of pig iron from local ports again. The same remarks apply to Canada and the United States. The iron ore trade continues to be quiet, and there is not much of a demand from outside the district. Foreign ores are arriving, but there is much restriction in delivery. The Barrow rail mills are still engaged, but fresh orders would be very welcome. A large fire float was transported from London to Barrow by road. It arrived at Barrow after an uneventful journey early on Sunday morning, and was lifted by one of Vickers' 150-ton cranes and floated in the dock. This float has been placed in the docks as an additional precaution against fire on board the many vessels laying up at the port or fitting out at Vickers-Armstrongs.

SHEFFIELD.

(From our own Correspondent.)

Iron and Steel.

SEASONAL quietude prevails in the iron and steel industries, and it is affecting nearly all departments, including those that have begun to feel the advantage of tariffs and favourable currency exchanges. Conditions generally are lifeless, with no evidence of a buying movement. In the heavy branches output continues more or less on previous levels, but orders show a downward tendency, and what few inquiries there are do not result in anything tangible. There has been a further increase in local unemployment, but most of the additions to the register consist of coal miners, the figures relating to the steel and allied trades being much as before. Makers of steel strip are more favourably placed than probably any other section of the finished steel trades. In a number of cases users who in the past have obtained their strip from foreign sources at lower prices than were charged at home find that the advantage no longer exists, as they are able to get British strip at approximately foreign prices and of quite satisfactory quality. One effect of the tariffs and exchange advantages has been to bring most of the trade in strip from abroad to English factories, many in Sheffield, and when general trade improves the benefit will be all the greater.

Export Trade.

Export business is seriously curtailed by the increasing difficulties in international trade from the fluctuation and depreciation of currency, and particularly from the foreign exchange restrictions. One effect of this adverse condition is to turn people's attention to the possibilities of barter trade. This subject is being studied, particularly in Germany, and important transactions, involving the exchange of raw materials or foodstuffs for finished products without any financial medium are reported from that country. Experiments have, however, revealed difficulties in adopting barter trade extensively, which appear to be insurmountable. The outlook for overseas business is, however, improving. Some of the Dominions are recovering slowly from their financial troubles, and having let their stocks of manufactured goods dwindle to vanishing point, they should soon be in a position to place substantial orders. Naturally, Sheffield has a special interest in Dominion recovery, for the city's steel products and other classes of manufactured goods are well known in all parts of the Empire where formerly they had a good market.

Steel Output.

Output of steel ingots and castings in the Sheffield area in May amounted to 63,800 tons, compared with 60,100 tons in April, and 63,500 tons in May last year. The Lincolnshire output in the same month was 34,200 tons, compared with 38,400 tons in April and 32,800 tons in May last year. Lincolnshire also produced 40,500 tons of pig iron, compared with 40,600 tons in April and 35,100 tons in May last year. A feature of the Sheffield returns was the small output of acid steel—18,600 tons, compared with 40,200 tons of basic.

The Lighter Trades.

The bright spots in the cutlery section are scissors and safety-razor blades, especially the latter, which should benefit immensely by the imposition of a special duty of 2s. a gross on all imports of safety-razor blades and blanks, in addition to the existing duty of 20 per cent. The consensus of opinion is that this new duty will give an impetus to the marketing of Sheffield safety-razor blades abroad, give more employment, and as the output increases place manufacturers in a position to compete more keenly for foreign trade in order to secure a good proportion of export orders for Sheffield. It is also considered that the new duty will not result in an increase in the retail price of blades to the British public.

Gas Grid.

Sheffield industrially is much interested at the present time in the development of the gas grid, which, it is hoped, is going to be a great asset in fuel economy and convenience to the steel industry, while at the same time being a big help to the collieries that will feed the surplus coke-oven gas into it. Other developments are taking place. For instance, Lysaght's, at their Scunthorpe works, are the first company in Great Britain to turn the waste gases from the blast-furnaces which make pig iron to use for heating coke ovens.

A Stephenson Bridge.

A link with Stephenson has been severed by the demolition of Horns Bridge on the London, Midland and Scottish Railway at Chesterfield. This bridge was built by Stephenson about 1839, and is a skew bridge with a square span of 25ft. Beneath it runs the main road from Chesterfield to Nottingham. The road, however, is too narrow for modern traffic conditions, and a widening scheme is to be undertaken. The Chesterfield authorities, aided by a grant from the Ministry of Transport, decided to carry out a scheme which involved the demolition of the old bridge, the erection of a new one, whereby the width of the road would be 50ft., and the sinking of the roadway by 2ft. 6in. The scheme was begun in March and will cost about £35,000. The removal of the old bridge was carried out by L.M.S. engineers with great skill. Owing to the proximity of property and the fact that another railway bridge passes overhead, explosives could not be used, and pneumatic drills were chiefly employed in the work of demolition, which entailed the taking up of the permanent way and the timber floor carrying it, the removal of fourteen temporary girders which had been erected so that the abutments to the new bridge could be built, the clearing off of the fillings from the arch of the old bridge before demolishing, cutting through and demolishing the old bridge, replacing that structure with a temporary girder bridge with seven girders, each 90ft. long, the laying of another temporary timber floor, and the replacement of the permanent way. The old Horns Bridge was shown to be a fine example of strength and good workmanship, the bricks, mortar, and asphalt all being in excellent condition. The work of demolition, which was not unattended with difficulty, was completed in twenty-six hours.

Trade with the Soviet.

A conference, arranged by the Sheffield Chamber of Commerce, between local traders and Soviet trade representatives, has lent added interest to the question of developing trade with Russia. At the present time Sheffield firms have orders on hand for large dredger buckets made of manganese steel, and steel pit props and roofs, whilst last year Russian work to the value of £450,000 was placed in Sheffield, the bulk of the orders being for steel works plant, circular saws, and coal-cutting apparatus. Provided further credit facilities were made available, substantial orders could be placed with Lincoln engineering firms by the Russian Government.

Electrical Contracts.

Within the past fortnight the English Electric Company, Ltd., has secured contracts for electrical engineering work amounting to £100,000. One is for the supply of 102 tramway motors for the London County Council, and the other is the contract in connection with the electrification of the Danish State Railways. This second contract includes the whole of the motors and control equipment required for forty-two motor coaches and twenty-one trailer coaches, and has been obtained in the face of keen competition with British and foreign firms. The electrical equipment will be manufactured at the Bradford works of the company. This is the first railway electrification scheme to be undertaken in Denmark.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

SOME slight further improvement in the general tone of the Cleveland pig iron trade is noticeable, but while confidence in gradual trade development continues, the volume of business is still disappointing, with purchases chiefly in small parcels for early delivery. Producers are, however, emphatic in their protest that quotations cannot be materially reduced until costs fall. Aggregate stocks of pig iron are hardly embarrassingly heavy, and as restricted output is not much in excess of requirements, little expansion of demand is needed to strengthen the statistical position. Overseas trade, in both Cleveland and hematite pig iron, has shrunk to small dimensions, but home sales are a little better and promise to increase. In order to maintain sales in Scotland makers are cutting prices severely, but they continue to quote the following prices to local consumers:—No. 1 Cleveland foundry, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

There is little alteration in the position of affairs in the East Coast hematite pig iron trade. Producers still ask 62s. 6d. for mixed numbers, and 63s. for No. 1 grade, but buyers state they can readily place orders at less. Second-hands still hold moderate quantities of hematite and keen sellers.

Ironmaking Materials.

There have been rather better sales this week of blast-furnace coke, but the price is no better at 15s. 6d. delivered at the works, and in the absence of actual business 15s. c.i.f. Tees is just a nominal figure for best Rubio ore.

Manufactured Iron and Steel.

A contract for 5000 tons of constructional steel has been placed by a London firm this week with Dorman, Long and Co., Ltd., Middlesbrough. Generally, business in finished material is a little less dull, but plant is still only moderately employed. Under the influence of a better demand galvanised corrugated sheets (24 gauge) have moved up to £9 10s. per ton. Other prices are unchanged.

The Coal Trade.

The Northern coal trade position remains dull, and buyers show little interest. Fresh inquiries are on a limited scale just now, and most of the collieries are working on old contracts. The warm weather has, of course, reduced domestic consumption to a minimum, and foreign business is difficult to procure. The quota scheme is sometimes blamed for the closing of pits and seams and the dismissal of miners, but the truth is that neither Durham nor Northumberland has reached the quota limits since the Coal Mines Act began to operate on January 1st, 1931. A few collieries may have got to the limitation point occasionally, but the counties have not had that experience. The curtailment of output is caused by want of trade, for if there were orders the district quotas would quickly be adjusted to meet the requirements. Up to the present July has been disappointing to collieries and exporters alike. In ordinary circumstances it is a quiet month, but it has been rendered unusually dull on account of the depression everywhere and the high barrier abroad against imports. Steam coals of all descriptions are only moderately booked, and output is consequently being kept down, while everything points to a further curtailment for the next few weeks. Meantime, all qualities are readily offered both for this month or to the end of the quarter, with prices weak at the schedule minimum. Conditions on the Continent will not allow consumers to pay even our present fixed prices, consequently, stocks are drawn upon or the orders placed with overseas producers at more favourable prices. Best Northumberland steams offer at 13s. 6d., and smalls at 8s. 6d. Tyne primes are moving moderately, with prices unchanged owing to limited output at 12s. 6d., while smalls are steady at 9s. The Durham gas coal trade is having a quiet time, and there are many lost days at the pits. Some undertakings prefer to lay off for a week rather than cease drawing coal on odd days; it lessens the cost to some extent. The best brands are slow of sale at 14s. 6d., as also are specials at 15s. Secondary descriptions are plentiful at 13s. to 13s. 6d. Coking coals are 12s. 6d. to 13s. 6d., according to grade, and bunkers are without feature at 13s. to 13s. 9d.

Coke Ovens to Restart.

It is cheering to learn that a coke-making undertaking in Durham is about to restart twenty ovens for the production of foundry coke. This will bring the output at the works near to the normal level. The coke is wanted for one or two blast-furnaces which are to be rekindled on Teesside towards the end of the month. In other respects the coke market is unchanged. Gas makes are steady at 17s. to 17s. 6d., but the export inquiry for patent ordinary is slow, and 14s. might be shaded for prompt shipment. Buying for winter needs is by no means active yet.

Wages Unchanged.

According to the accountant's certificate the ascertained selling price of No. 3 Cleveland pig iron for April, May and June, 1932, is 52s. 8·25d. per ton. The North-East Coast blast-furnacemen's wages will remain unaltered for the third quarter of 1932—that is, neither base rates nor bonus will carry any percentage for the current quarter. The Cleveland ironstone miners' wages will also remain unaltered. Under the operation of the sliding scale, based on the ascertained price of No. 3 Cleveland iron, the owners were entitled to a small reduction in the rates of pay, but they waived their claim.

SCOTLAND.

(From our own Correspondent.)

Holiday Markets.

THE annual holidays began last week in the east of Scotland, and on Thursday of this week the west of Scotland follows suit. In some cases, owing to the state of trade, the holidays will extend until August. Markets have not been affected to any extent, there being very little evidence of any anxiety on the part of consumers to cover requirements during the vacation.

Steel.

In view of the holidays home consumers have been taking smaller deliveries, and specifications for all classes of material are scarcer. Orders for heavy steel are not likely to improve for some time, though rumours of possible shipbuilding contracts have encouraged a more hopeful feeling. The majority of the works will be closed for at least two weeks, beginning on Friday of this week.

Sheets.

Steel sheets are comparatively quiet at the moment. Heavy gauges of black sheets and light plates have few inquiries, and the lighter sorts are not so well

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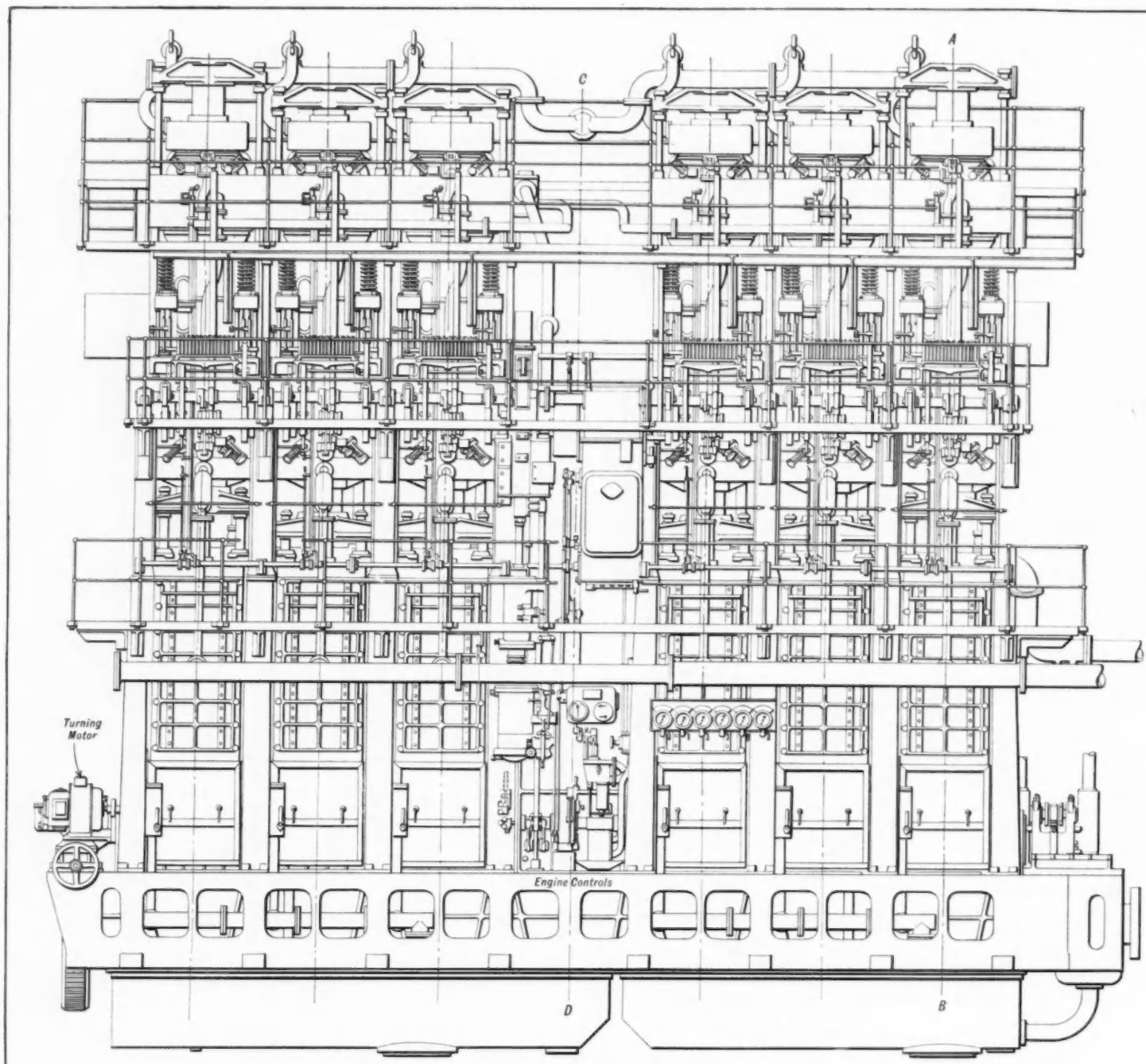
6000 B.H.P. DOUBLE-ACTING TWO-S

BURMEISTER AND WAIN, LTD., CO



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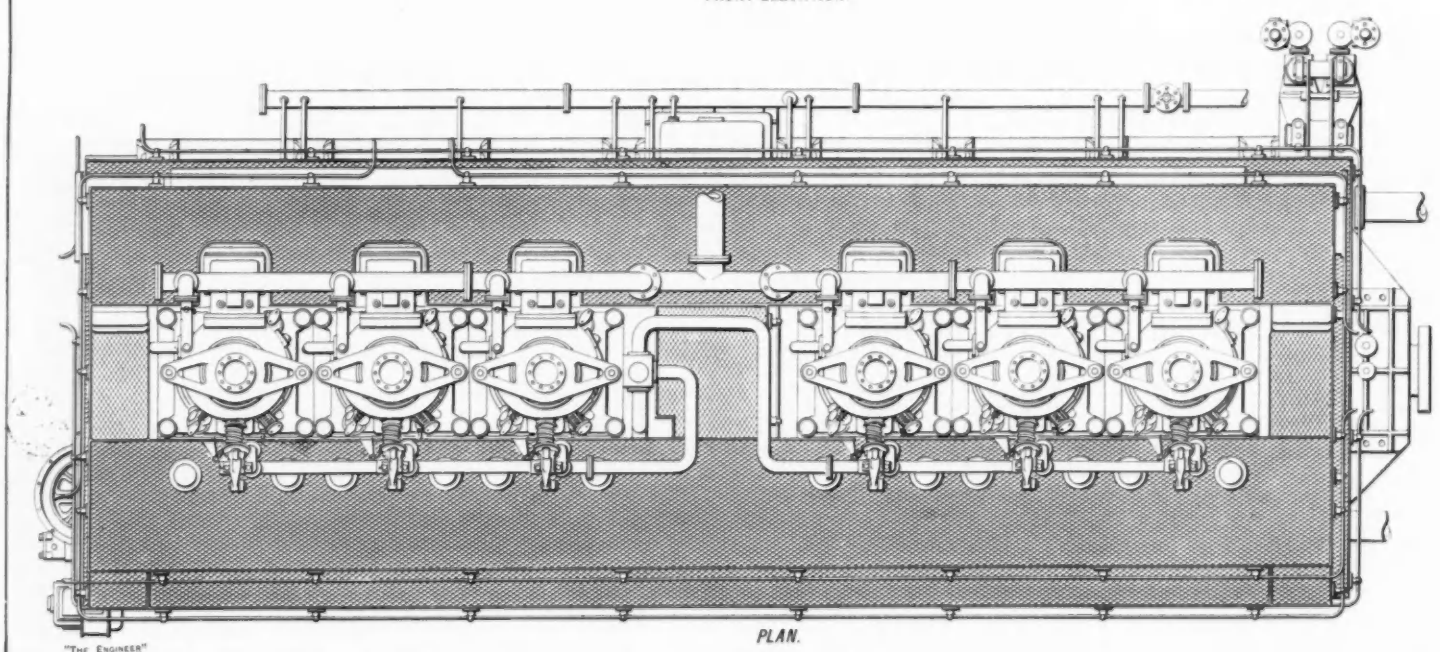
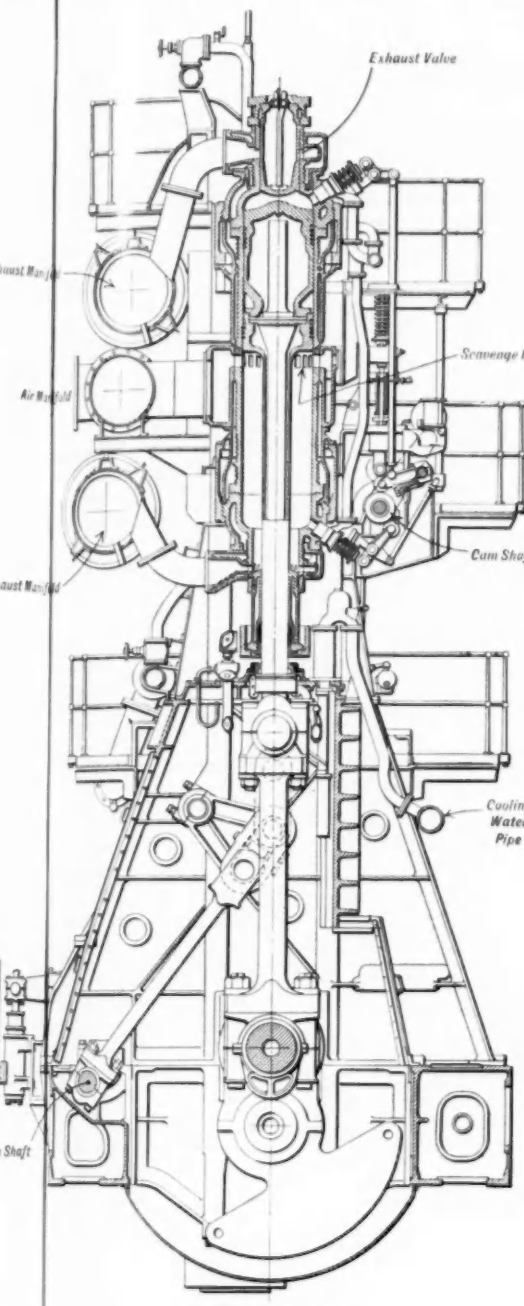


PLAN.

"THE ENGINEER"

TWO-STROKE MARINE OIL ENGINE

N, LTD. COPENHAGEN, ENGINEERS



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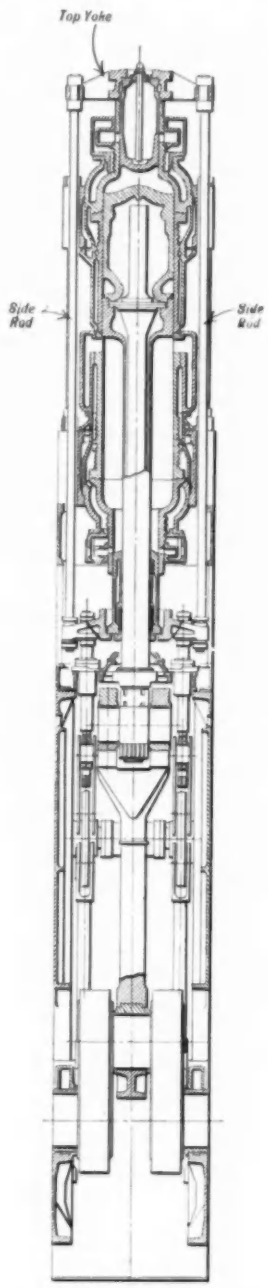

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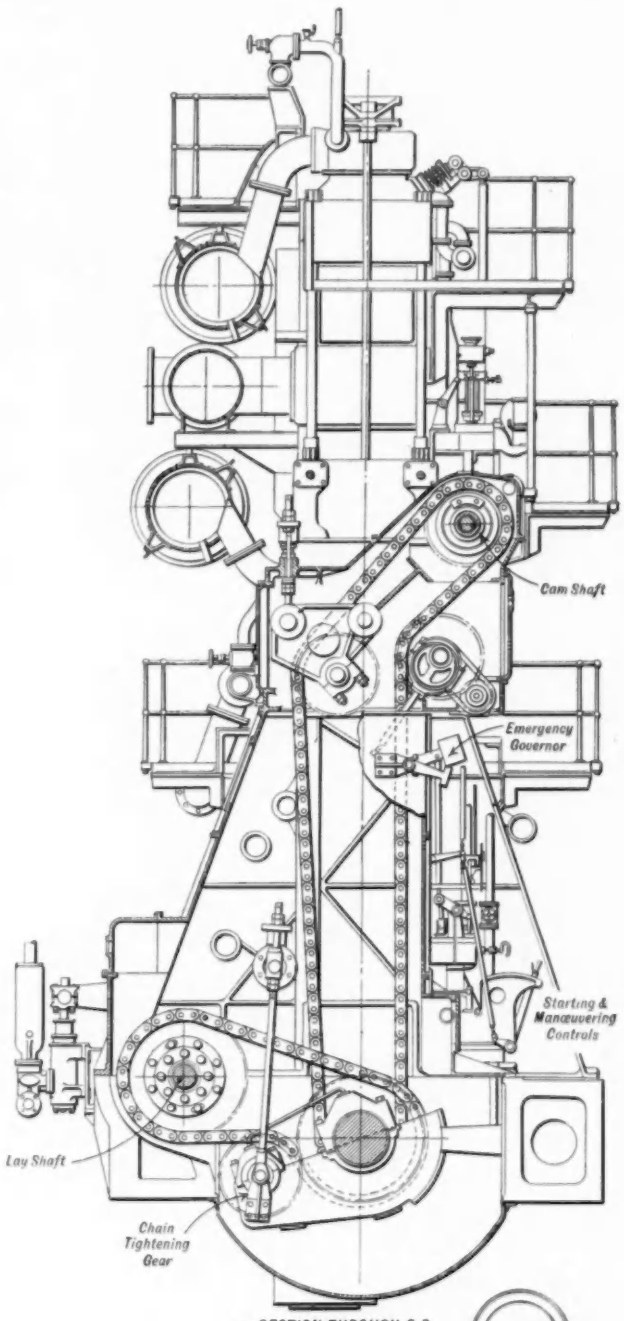

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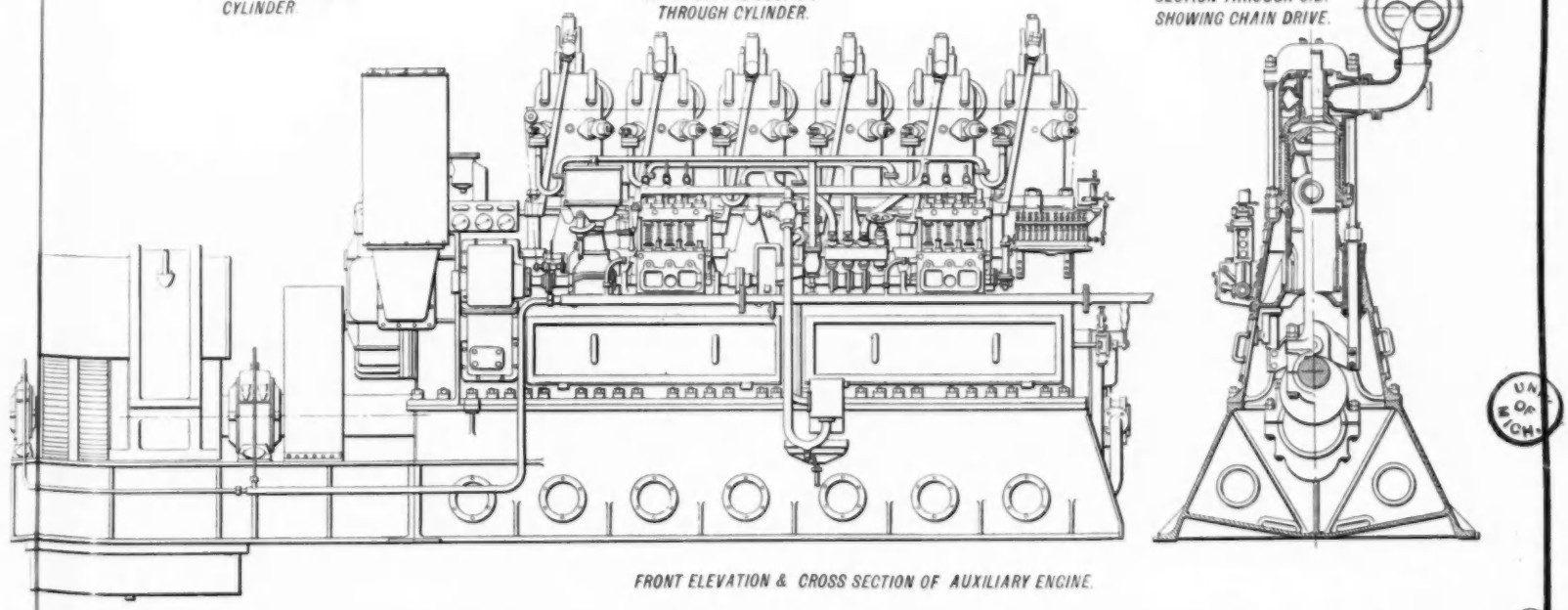


FRONT ELEVATION & CROSS SECTION OF AUXILIARY ENGINE.

UNIV. OF MICH.

specified as they were a few weeks ago. Galvanised sheets have a most erratic demand, and despite low quotations the flow of orders is rather disappointing. Some makers are of the opinion, however, that an expansion in turnover cannot be long delayed.

Iron.

Business in iron does not yet show a recovering tendency. Bar iron continues on a high level compared with competitive material, and the same may be said of re-rolled steel bars at £6 10s. home (fixed) and £6 7s. 6d. per ton export.

Pig Iron.

The number of furnaces in blast in Scotland remains at six, and supplies are ample. Consignments still arrive in this district, 2700 tons coming in last week, of which total 2250 tons came from Calcutta and the remainder from Barrow.

Scrap.

The weakening tendency in scrap continues, heavy steel being now in the region of 35s. and cast iron machinery 45s. per ton.

Coal.

The firmness of washed treble nuts, especially in Fifeshire, still constitutes the outstanding feature of the coal market. Best Fifeshire steams have moved freely of late, but practically all other fuels are easily obtainable for prompt delivery. Home requirements as a rule are below normal, owing to the drop in industrial demands, while export, of course, is still hampered by the restrictions on imports abroad. Aggregate shipments during the past week amounted to 234,499 tons, against 247,940 tons in the preceding week and 221,250 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

DESPITE the apparent quietness in the coal export trade, the fact remains that shipments are being well maintained. Last week the volume of chartering was, if anything, greater than for several weeks previously, so that the returns of coal shipments for this week should be fairly satisfactory. The returns for last week showed that the total was 404,780 tons, which compared with 397,185 tons for the preceding week, and with 396,823 tons for the corresponding period of last year. For once in a way the figures relating to the dock position at the end of last week were better than usual, as the total of vacant loading berths was thirty-seven, whereas not so long ago the total was round about fifty. This week began with the number of vacant berths being twenty-nine, and on Tuesday this figure was reduced by two, so that it is evident that there is slightly more activity in shipment operations, even at the steam coal ports. As regards the anthracite section, the situation is as strong as ever. There were eleven steamers waiting at Swansea on Saturday, while on Monday this total was increased to thirteen. As a matter of fact, shipowners are a little uneasy at the detention which steamers may suffer by going to Swansea to load. Anthracite coals are very scarce and the position in this respect was made more difficult on Tuesday by the fact that some of the miners at one of the leading collieries in the amalgamated group came out on strike, though it is hoped that their suspension of work will be only of a temporary character. Strange as it may appear, difficulty is experienced in stemming some steam coals, as well as anthracite, but the trouble arises from different causes. In the case of steam coals work at the pits is so irregular on account of the paucity in the demand for large coals that the output of sized steam coals is detrimentally affected, but in the case of anthracite qualities all grades of coal are unequal to the current demand. While, however, the day-to-day inquiry for steam coals provides no real feature the future is regarded rather more hopefully. The Lausanne agreement for the removal of the reparations trouble is looked upon as a favourable factor for the coal trade of this country. Many consumers abroad have been compelled to take reparation coals, whereas they would undoubtedly have preferred to come to this market for their requirements. Further, it is well known that Italy has large stocks of German coals, but when they have been reduced it is not at all improbable that that country will consider taking increased quantities from the United Kingdom, particularly for the Italian State Railways. Exporters and coalowners here are also keeping a close watch upon events on the Continent, and the fact is not being overlooked that the strike of miners now in progress in the Belgian coalfield may mean a flow of orders to this country. Even now offers have been sought for coals for prompt delivery, though business has not yet materialised. As regards contract operations the Spanish Navy authorities have asked for prices for about 8000 tons of best steam coals for delivery the end of August and early September, while the Peloponesus (Greek) Railways have invited tenders for the supply of 30,000 tons of patent fuel to be delivered from September to May next.

Back to Coal Movement.

The movement in this district for promoting the use of coal, and particularly the reversion from oil to coal in the British Navy, is displaying considerable vitality, as is shown by recent correspondence between the Lord Mayor of Cardiff and the Secretary of Mines and Mr. Stanley Baldwin, Lord President of the Council. This correspondence arose from the fact that last week the report became current that the Government had decided to refuse the inquiry requested by the movement. Mr. Isaac Foot, the Secretary for Mines, in his letter to the Lord Mayor, reiterates his opinion expressed in the House of Commons that he does not believe that a Commission of Inquiry would serve any useful purpose, but, at the same time, he denies that any decision has been come to by the Government. The Lord Mayor of Cardiff, in his reply, stresses the importance of the coal question and points out that it demands the attention not of one Department of the Government, but of a Commission of Inquiry which can utilise and bring out in its proceedings and ultimate report the information which may have already been collected by the Mines Department and by any other Government Department which may be concerned in the fuel problem.

Docks Facilities and Economies.

Strenuous efforts are being made, especially by all traders at Penarth, to secure that the Penarth Docks shall not be closed by the Great Western Railway Company, which is seeking to effect the utmost economy in view of the fact that coal shipments are on such a reduced scale compared with more normal periods. It appears that the final decision is to be come to by the directors of the G.W.R. Company at their next meeting as to what steps shall be taken to effect the economies that are desired. A deputation from Penarth traders had an interview with the general manager of the company last week, and subsequently it was understood that the Earl of Plymouth had made a very generous offer, viz., to forego royalties payable to his estate for one year in respect of goods handled at Penarth, in an effort to avoid the closing of the Penarth Dock. In normal times the royalties have amounted to as much as £12,000 a year, but at present are about £3500. It was also disclosed at the interview last week between the G.W.R. Company's general manager and the deputation that the losses sustained by the company at Penarth last year were more than £13,000.

S.W.M.F. Finances.

The balance sheet of the South Wales Miners' Federation for 1931 shows a decline in the average paying membership from 75,480 to 62,089 and in receipts from contributions and political levy from £51,358 to £37,031. The total expenditure for the year was £56,700, compared with £44,540 the previous year.

Tonnage Laid Up.

The latest return shows that there are at present sixty-nine British vessels of 381,525 deadweight tons laid up in the South Wales docks of the Great Western Railway Company. Of this number no fewer than fifty-six, of 320,492 tons, equal to nearly 80 per cent. of the total, are locally owned. On July 1st last year the number of vessels laid up was sixty-eight, of 371,827 tons deadweight.

Welsh Tin-plate Council.

At the annual meeting of the Joint Industrial Council for the Welsh tin-plate trade, held at Swansea on Monday, it was decided that the sliding scale agreement which the employers had given notice to terminate at the end of this month, should be continued for a further three months, during which period a joint sub-committee will consider the situation. A joint committee was also appointed to consider proposals with a view to absorbing in the tin-plate trade labour displaced owing to industrial depression. The employers also intimated that they could not agree to the men's claims for payment of wages during the annual holiday week. A suggestion respecting the establishment of a superannuaton fund for workmen was referred to a joint committee.

Air Service.

With a view to developing Cardiff as an air port, an experimental air service was inaugurated on Monday between Cardiff and Bristol, Captain C. D. Barnard, the famous pilot, completing four journeys each way with passengers. The service continues throughout this week. The average time taken by the air liner on Monday on the journeys was eighteen minutes. In favourable weather the voyage in direct line across the Bristol Channel will occupy twelve minutes.

Current Business.

Operations in steam coals from day to day have been quiet and so far as prices are concerned there has been no change. Dry qualities continue to be scarce, especially sized descriptions. All other coals were freely offered and were in excess of the demand. Coke was a slow section, but patent fuel was fairly well stemmed. Pitwood displayed no improvement.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

G. AND J. WEIR, Ltd., inform us that their Manchester office address has been changed to 44, Corporation-street, Manchester.

EDWARD G. HERBERT, Ltd., Manchester, has appointed Aktieselskapet Heimdal Maskinforretning, Raadhusgt, 1–3, Oslo, as their sole agents in Norway for "Rapid" and "Rapidor" sawing machines, saw-sharpening machines, and high-speed steel saw blades.

MR. CHARLES PULLAN, for many years representing Messrs. Armstrong, Stevens and Son, Birmingham and Willenhall, in the North of England, has been appointed sales representative to Sir W. G. Armstrong, Whitworth and Co. (Ironfounders), Ltd., Gateshead-on-Tyne.

THE METROPOLITAN-CAMMELL CARRIAGE WAGON AND FINANCE COMPANY, Ltd., and WEYMANN'S MOTOR BODIES (1925), Ltd., announce that a new company has been registered, entitled "Metropolitan-Cammell-Weymann Motor Bodies, Ltd." This new company will control the design and production of the all-metal body developed by the Metropolitan Cammell Carriage Wagon and Finance Company, Ltd.

RICHARD DUNSTON, Ltd., shipbuilders, of Thorne, Yorkshire, has recently acquired the whole of the share capital of the old-established shipbuilding company of Henry Scarr, Ltd., Haven Shipyard, Hessle, near Hull. The sole directors of Richard Dunston, Ltd.—K. S. A. Dunston and Richard Dunston, with the latter as managing director—are also now the sole directors of Henry Scarr, Ltd., and both the Thorne and the Hessle shipyards will work under their control.

CONTRACTS.

RICHARD DUNSTON, Ltd., of Thorne, Yorks., has received an order from Hull owners for the construction of a steel barge for service in the grain trade on the Yorkshire waterways.

BLACKSTONE AND CO., Ltd., Stamford, have recently received contracts from thirteen municipal and other authorities for thirty-five Blackstone "Unchokeable" crude sewage and sludge pumps.

JOHN I. THORNYCROFT AND CO., Ltd., have received a contract from the Admiralty for the construction of two harbour launches. These launches are to be 52½ft. in length, will be fitted with heavy-oil engines, to which will be coupled the new Thornycroft type R25 reverse gear.

CATALOGUES.

ENGLISH STEEL CORPORATION, Ltd., Vickers Works, Sheffield.—A 100-page booklet on high-grade tool steels.

REDFERN'S RUBBER WORKS, Ltd., Hyde, near Manchester.—List A 438 of mechanical and general rubber goods.

CROFTS (ENGINEERS), Ltd., Thornbury, Bradford.—Detailed catalogue of double helical reduction and increasing gears.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Publication No. 1490 on electrostatic precipitation.

VACUUM OIL COMPANY, Ltd., Caxton House, London, S.W. 1.—"Gargoyle" Technical Series No. 7 on "Wire Ropes: Their Care and Treatment."

ELLIOTT BROS. (LONDON), Ltd., Century Works, Lewisham, S.E. 13.—Catalogue 812 of Siemens electrical recorders for heat economy and control.

WADDELLS (STRATFORD STEEL EQUIPMENT), Ltd., Hallroad, Stratford, E. 15.—Catalogue W 79 of steel equipment for factory and warehouse.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester.—Special Publication No. 7250/5, dealing with switchgear for low and medium pressures up to 650 volts.

INDUSTRIAL BRITAIN.—A world-wide campaign to give publicity to the achievements of British industry is begun by the publication of the first number of *Industrial Britain*. This is a news bulletin which is to be published monthly by the Travel and Industrial Development Association of Great Britain and Ireland. The bulletin, which is a journal of information for editors and industrialists in all parts of the world, is written in English, French, and German. Its contents consist of news relating to the industrial development of the country as a whole, and of those sections in particular which have created, or are in process of creating, industrial development councils or associations.

LAUNCH OF H.M.S. "DIANA" AT JARROW.—On Thursday, June 16th, Palmers Shipbuilding and Iron Company, Ltd., launched from the Jarrow Shipyard the destroyer "Diana," which the firm is constructing for H.M. Navy under the 1930 programme. The vessel has a length of 317ft. 9in., a breadth of 33ft., and on her standard displacement of 1375 tons will have a mean draught of 8ft. 6in. Her propelling machinery, constructed at the builders' engine works at Jarrow, will have an estimated horse-power on full-power trial of 36,000, at which power the vessel will attain a speed of about 35½ knots when loaded to her standard displacement. The armament includes four 4·7in. guns and one 3in. anti-aircraft gun.

INTERNATIONAL CONGRESS ON COMMERCIAL EDUCATION.—An International Congress on Commercial Education will be opened by the Lord Mayor in the Grocers' Hall, on Monday, July 25th. The delegates are being entertained by the Government at a reception at Lancaster House that evening, while on the following evening, Tuesday, July 26th, a reception is being given to them by the Lord Mayor and Corporation in Guildhall. The closing session of the Congress, of which Sir David Milne-Watson is President and Sir Francis Goodenough Organising Chairman, will also be held in the Grocers' Hall; and H.R.H. the Prince of Wales has promised to attend and address the Congress on that occasion. Nearly 500 delegates, representing thirty-five countries, have registered for attendance at the Congress.

OTTAWA CONFERENCE: STANDARDISATION.—The question of industrial standardisation will again come before the Imperial Conference when it meets in Ottawa at the end of this month, and Mr. C. le Maistre, C.B.E, Director of the British Standards Institution, has been appointed Adviser to the United Kingdom Delegation on British Standards. It will be recalled that at the last two Imperial Conferences very great importance was attached to the development of inter-Empire standardisation, and to the preparation of national industrial specifications by the national standardising bodies in each of the constituent parts of the British Commonwealth of Nations. In order to fulfil the recommendation of the last Imperial Conference, the British Engineering Standards Association quite recently widened its scope, and is now known as the British Standards Institution.

LLOYD'S REGISTER WRECK RETURNS.—Some very interesting comparisons can be made by a careful analysis of the wreck returns just issued by Lloyd's Register. We know, of course, that "statistics can be made to prove anything," but it certainly seems that British ships are the best to go aboard. We still possess a preponderating share in the world's shipping, with 23,000,000 tons, including the Dominions, and our losses during the year amounted to only 23,500 tons. That figure includes the loss of the "Bermuda," which was burned tied up in the repairer's yard, and can hardly be described as a marine loss. Excluding her, our losses from all causes were only 4400 tons, or about one in two million tons. The next largest owner of shipping (we are concerning ourselves only with steam and motor ships) is the United States, with some 10,000,000 and losses of about 10,600 tons, or, shall we say, one in a thousand. Passing by several other countries, we come to Greece, with a total of nearly 1,400,000 tons and losses of over 12,000 tons.

ENGINEERS' GERMAN CIRCLE: SUMMER VISIT.—The first summer visit of the Engineers' German Circle took place on Saturday last, July 9th, when some sixty members and guests visited the Air Port of London at Croydon Aerdrome. The main party travelled by coach from St. James's Underground Station and on arrival at Croydon was joined by other members. Herr R. A. Jahn, the London manager of the Deutsche Luft Hansa A.G., received the party and explained the arrangements at the aerodrome and the special services of the German Airways. One of the Junkers night service mail planes was inspected. By arrangement with Imperial Airways many members availed themselves of the opportunity for a flight in the "Hengist," one of the new four-engined 42-seater Handley Page machines. Tea was served in the Aerodrome Hotel and Director Kocher and Mr. Chas. King thanked Herr Jahn for the great interest he had shown in the visit and the painstaking explanations he had given. The arrangements were excellently carried out by Mr. H. P. Spratt, of the Science Museum, South Kensington, the Secretary of the Circle.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/–
(1) Spanish	17/– to 22/6
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	15/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 2 6	3 2 6
No. 1	3 3 0	3 3 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*)	—
	4 0 6 (*b*)	—
	4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	9 5 0 to 9 7 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/9 to 15/3
Block Tin (cash)	125 15 0
„ (three months)	127 10 0
Copper (cash)	26 12 6
„ (three months)	26 7 6
Spanish Lead (cash)	10 3 9
„ „ (three months)	10 12 6
Spelter (cash)	11 11 3
„ (three months)	12 1 3
MANCHESTER—	
Copper, Best Selected Ingots	30 10 0
„ Electrolytic	31 10 0
„ Strong Sheets	59 0 0
„ Tubes (Basis Price), lb.	0 0 9½
Brass Tubes (Basis Price), lb.	0 0 8½
„ Condenser, lb.	0 0 11
Lead, English	12 5 0
„ Foreign	10 10 0
Spelter	12 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/3½ per lb.	
Ferro Tungsten	2/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£23 15 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 10 0	12/–
„ „ „ 1 p.c. carbon	£47 2 6	14/–
„ „ „ 0·70 p.c. carbon	£52 0 0	14/–
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 unit	scale 5/– per
„ „ 75 p.c.	£19 0 0 unit	scale 7/– per
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	8/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/–
„ „ Ell	14/–
„ „ Splint	13/9 to 14/9
„ „ Trebles	12/6
„ „ Doubles	10/–
„ „ Singles	8/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	11/9
„ „ Jewel	10/6
„ „ Trebles	12/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 13/–
Screened Navigation	16/6
Trebles	13/6 to 15/6
Doubles	10/6 to 11/6
Singles	9/3
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/– to 11/6
Secondary Steam	10/6
Trebles	13/6
Doubles	10/6 to 11/–
Singles	8/9 to 9/–

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	21/9
Household	32/6 to 51/8
Coke	19/– to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–
SHEFFIELD—	
Best Hand-picked Branch	25/– to 26/– —
South Yorkshire Best	20/– to 21/– —
Derbyshire Best Bright House	20/– to 21/– —
Screened House Coal	15/6 to 16/6 —
Best Screened Nuts	15/– to 16/– —
Small Screened Nuts	13/6 to 15/6 —
Yorkshire Hards	16/– to 18/– —
Derbyshire Hards	16/– to 18/– —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	7/– to 8/6 —
Blast-furnace Coke (Inland)	11/– to 12/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 16/6	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	19/– to 25/–
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	20/–
Pitwood (ex ship)	19/6 to 20/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	11/– to 11/6
Steam Coals:	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Outlook.

In the absence of any pronounced optimism in the immediate future of the engineering trades there is a general opinion that the settlement of reparations will prove the beginning of a real effort to bring about a recovery in commerce and industry, though little progress can be accomplished until something is done to remove the economic distress in Central Europe. All the countries have shown a desire to work together in the common interest so long as it coincides with what each country regards as the national interest, and French manufacturers expect that there will be long and tedious negotiations before Europe is able to show a unity of method in dealing with the problem. The French Government has made a profession of faith in the necessity of suppressing import quotas and lowering gradually the tariff barriers, but Governments in this country are not noted for their longevity, and when manufacturers are agitating for a new Tariff Bill which will give them more effective protection it would be unwise to count too much upon the official plans for opening the door wider to foreign trade. Nevertheless, the present system is giving results that threaten to place French production outside the pale of competition in foreign markets, and hope for the future is held to lie more particularly in manufacturers from different countries meeting and settling upon a fair arrangement for an exchange of products.

Paris Transports.

Since the Paris urban transports came under the control of the General Council of the Seine all the plans have aimed at unifying public services throughout the Department, and the omnibuses and Metropolitan Railway are both being extended beyond the old Paris boundaries. So far as the suburban railways are concerned most of them continue to be worked by the railway companies themselves, and on the State Railways all the suburban lines are now electrified. The Paris-Orleans suburban lines, however, are being absorbed by the Metropolitan Railway, which will start immediately upon the work of incorporating into its system the railway to the suburban town of Sceaux and this will be followed by the linking up of other lines. So far as concerns the Paris omnibus and tramway services the General Council of the Seine has rejected the demand of the existing company for a renewal of its concession and also the demand of a new company which was to work the surface transports in conjunction with the Metropolitan Railway, in which event this latter company, which sponsored the new company, would have a monopoly of public transport throughout the Department. The General Council has now veered round in favour of farming out the omnibus and tramway services to a company under conditions similar to those of the company which is exploiting the gas distribution for the Municipal Council. It is a modified form of Socialist working, although leaving the company with some initiative and a good deal of responsibility, and it still lays the way open to political interference and inefficient service which are arousing increasing opposition in this country against the State and municipal authorities running industrial undertakings.

The Congo Railway.

The construction of the railway between Brazzaville on the Congo and Pointe-Noire on the coast is one of the most arduous undertakings yet attempted, and it was only when a disastrous experience had shown the unsuitability of native labour for the work in an unhealthy territory that the French changed their methods and resumed the construction of the railway with the aid of as complete a mechanical equipment as possible. Steady progress is now being made with the railway, which, it is hoped, will be completed in 1934. The total length of the line is 320 miles. The Société des Batignolles is building the railway from Pointe-Noire, and the spiral tunnel through the Bamba mountain is making satisfactory headway. The section of the railway from Brazzaville is being constructed by the Colony of Equatorial Africa. At each end of the railway sections are being worked over distances of 78 and 92 miles respectively, and communication is effected between them by motor vehicles, so that there is already a certain amount of traffic between Brazzaville and the coast.

Canal des Deux Mers.

The scheme for constructing a canal across France from near Narbonne on the Mediterranean to Arcachon on the Atlantic is an old one and dates from the time when it was hoped to give the French fleet access to the two seas without the necessity of passing through the Straits of Gibraltar. Such a canal would have no strategical value nowadays, but in the South of France it is regarded as of immense value as a means of diverting a part of the world shipping across the country and of making Toulouse a great inland port. The scheme is revived periodically, and there was a congress in Toulouse last week to further the interests of the Canal des Deux Mers. It is proposed to construct the canal 13·5 m. deep and 60 m. wide at the bottom and 150 m. wide at the water level. A demand for a concession to build it has even been presented to the Ministry of Public Works. The Canal des Deux Mers has always been regarded by the State engineers and others as one of those plausible schemes that cover all kinds of impediments and difficulties, and the estimated cost of more than 9000 million francs is not likely to encourage the State to authorise the carrying out of such an undertaking when there is so much to be done in other ways and no money to do it with.

The Promethee Disaster.

The Prométhée was one of twenty-five of its class of submarines with a surface displacement of 1379 tons. The cause of its sinking off Cherbourg with the hatches open cannot be explained except on the assumption that there was some mistake in manœuvring. There is a depth of 50 m. of water where the disaster took place, and the submarine sank in a depression 75 m. deep and was located by the telephone buoy which had been released. The loss of the Prométhée has made a strong impression on public opinion.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

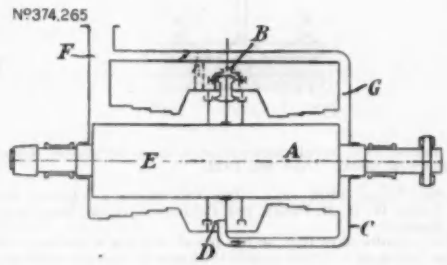
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

374,265. June 4th, 1931.—STEAM TURBINES, John I. Thornycroft and Co., Ltd., Smith-square, Westminster, and H. E. Sharp, Woolston Works, Southampton.

The object of this invention is to permit the economical running of a steam turbine at various loads. The turbine itself is of the double-flow type. For low powers high-pressure

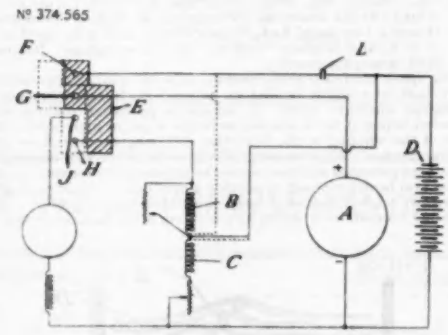


steam is admitted to the end A of the turbine at B, and is exhausted through C to be further expanded through the nozzles D, and after passing through the E end of the turbine finally exhausted at F. For intermediate powers high-pressure steam is also admitted to the E section of the turbine. For full power high-pressure steam only is used in both sections, and the exhaust from A goes to the condenser by the pipe G.—*June 9th*, 1932

DYNAMOS AND MOTORS.

374,565. April 9th, 1931.—DIRECT-CURRENT GENERATORS, Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., of Park House, 22–26, Great Smith-street, Westminster, London, S.W. 1, and Charles Murray Beckett, of 55, Wordsworth-drive, Cheam, Surrey.

In accordance with this invention, means are provided whereby a high-voltage generator may be converted at will to a low-voltage generator. A is the armature of a high-voltage machine and B and C its shunt winding, C being an independent winding portion which is connected across a storage battery D (of 50 volts, for example). The negative terminal of the winding C is also connected to the negative side of the armature. A change-over switch E has contacts F, G, H, and J, and drum segments arranged so that in the "load" position, shown in dotted lines, the positive terminal of the generator, connected to contact G is connected to contact J, which is connected to the load,

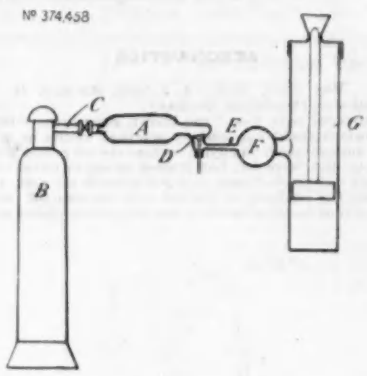


shown in the drawing as a series motor. Contact G is also connected in this position of the switch to contact H, which is connected to the positive terminal of the self-excited winding B. The negative terminal of the self-excited winding is permanently connected to the positive terminal of the independent winding C. Under these conditions, the generator operates as a variable voltage generator capable of supplying load from low voltages to a maximum voltage. When it is not required for use as a variable voltage generator, it may be used as a low-voltage generator for charging the battery, and for this purpose the switch E may be moved to the "battery charging" position, shown in full lines, in which contacts H and J are isolated and contact G is connected to contact F, which is permanently connected, through a reverse current relay L. The generator then operates as an approximately constant voltage shunt-wound generator.—*June 16th*, 1932.

SWITCHGEAR.

374,458. March 4th, 1931.—GAS-BLAST ELECTRIC SWITCHES AND CIRCUIT BREAKERS, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

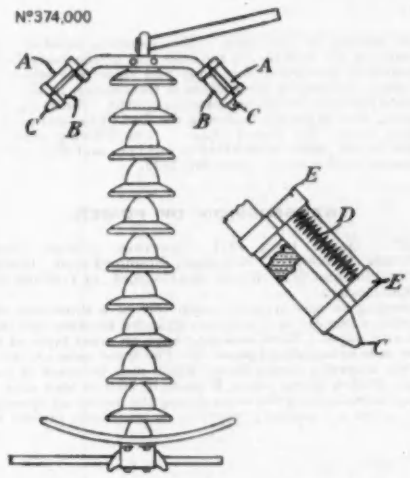
The primary object of this invention is to ensure that the vaporisation process of the liquid carbon dioxide, for the extinction of arcing in gas-blast electric switches or circuit breakers, shall take place more economically than hitherto, and the invention consists in arranging the volume of the stored liquid carbon dioxide to be so related to that of the region in which the liquid is to be admitted for vaporisation that the resulting pressure of the vaporised substance is less than 5·3 atmospheres absolute. A is a chamber which is arranged to be fed with and to hold, prior to operation of the switch a charge of liquid carbon dioxide obtained from the container B, the liquid being admitted to the chamber A through a valve-controlled supply pipe C. The chamber A is connected through a valve D and an outlet pipe E, with a distribution chamber F, leading to the switch chamber G. Thus, a predetermined quantity of liquid carbon dioxide is stored in the chamber A, and, upon raising of the valve D from its seat, the quantity contained in this chamber flows through the pipe E, and the distribution chamber F, into the switch chamber G of the gas-blast switch, where it serves both for blowing out the arc at the switch contacts as well as moving the actuating piston for the movable contact. The volume enclosed by the portions E, F, and G may therefore be described as the region in which the vaporisation of the liquid carbon dioxide stored in the chamber A occurs, and, according to the invention, the volume of the charge of liquid contained in the



chamber A is so related to the combined volume enclosed by the portions E, F, and G that the resulting pressure of the vaporised charge is less than 5·3 atmospheres absolute. In the case where the prevailing temperature is 20 deg. Cent., the volume of the chamber A is to the combined volume of the portions E, F, and G in the ratio of approximately 1 : 10.—*June 6th*, 1932.

374,000. January 29th, 1931.—ARC EXTINGUISHING DEVICES, *the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

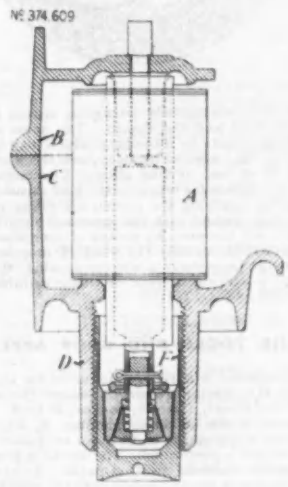
In accordance with this invention, fuses A are connected in shunt with insulating portions B of at least one of the arcing horns having arcing tips C. The fuses are enclosed in glass tubes



and are held in position by clips, the tubes being filled with carbon tetrachloride or other extinguishing liquid. The tension spring D and the fuse are in series, and when the fuse melts, the arc is drawn into the liquid by the spring.—*May 30th*, 1931.

374,609. May 23rd, 1931.—ELECTRIC CIRCUIT BREAKERS, George Ellison, of Wellhead-lane Works, Perry Barr, Birmingham, and George Ellison, Ltd., of the same address.

This invention concerns electric circuit breakers of the type in which the movement of a solenoid plunger is controlled by the piston of a dashpot. The object is to combine the dashpot with the solenoid in an improved manner, resulting in simplification



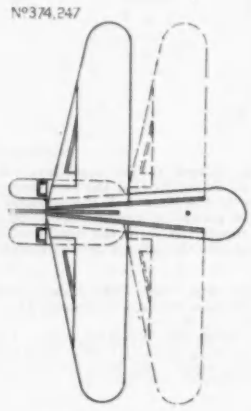
of construction and improved appearance. The device comprises a boss formed integrally with the exterior iron portion of the solenoid, and a dashpot cylinder having its upper end screw-threaded for engagement with the boss, the lower end of the plain part of the cylinder being arranged to extend beyond the lower end of the boss. The iron portion containing the solenoid winding A consists of separate upper and lower parts B, C, and on the

underside of the lower part there is a hollow boss D coaxial with the solenoid winding. The boss is screw-threaded internally and adapted to accommodate the cylinder F of the dashpot. The upper end of the cylinder is screw-threaded to provide an adjustable connection with the boss. The lower plain end of the cylinder which projects to a convenient extent beyond the lower end of the boss is graduated, so that the dashpot can readily be set to any desired position. By so combining the dashpot with the solenoid case it is possible to obtain a simple and convenient construction, in a neat and compact form.—*June 16th*, 1932.

AERONAUTICS

374,247. May 22nd, 1931.—A FLYING ROCKET, R. Tiling, Flughafen, Osnabrück, Germany.

The inventor says that "the known suggestions relating to flying rockets could not lead to practical results as a secure landing was excluded. As flying rockets are not pulled like other aircraft by the propeller, but pushed owing to recoil effect of the highly compressed gases expelled towards the rear, a flying rocket has the tendency to deviate from the straight path. In order to overcome this tendency the supporting planes required

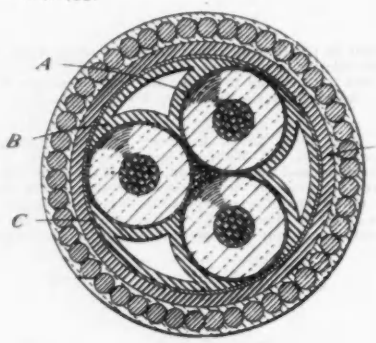


for the landing are, according to the invention, situated during the firing of the rockets on the rear end of the body behind the centre of gravity of this body and enter into effect only after the propelling of the rockets is terminated, in that they are either shifted forward, oscillated or spread. The flying body, therefore, acts as projectile during the first phase and as flying machine during the second phase." The drawing shows the position of the planes at starting in full lines and their forward position in broken lines.—*June 9th*, 1932.

TRANSMISSION OF POWER.

374,537. March 18th, 1931.—ELECTRIC CABLES, Charles James Beaver, of Bell-place, Stamford-road, Bowdon, Cheshire, and W. T. Glover and Co., Ltd., of Trafford Park, Manchester.

According to this invention each core of a three-core cable comprises a number of conductors stranded together and insulated with paper. Each core may have an outer layer of thin copper tape or metallised paper A. The three cores are laid up together around a centre filling, which may be made of paper string. Hollow filling pieces H made of lead or lead alloy are laid up helically with the cores during the laying-up operation. These tubes are generally made by an extrusion process of a

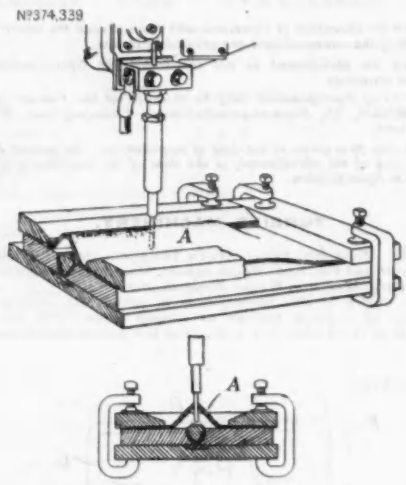


shape to fit the substantially triangular spaces between each two adjacent cores and the sheath. The cores and tubes are held together generally by a binder C which may be in the form of a thin metal tape applied helically, and the whole is enclosed in a sheath D of lead or lead alloy. The metal tape serves in addition as a means for relieving the lead sheath from internal pressure. After applying the sheath the filling pieces may be forced into close contact with the cores and sheath by applying fluid pressure, for instance, by means of compressed air, to the interior of each of the tubes. The sheath D may be covered with a layer of jute and may have a wire armouring, the latter being covered with a serving of jute or other suitable material.—*June 16th*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

374,339. September 3rd, 1931.—METHODS OF AND APPARATUS FOR ARC WELDING, *the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

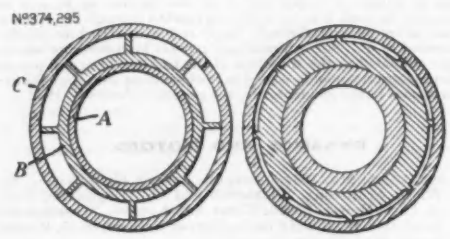
The purpose of the shielding member A, which forms the subject of this invention, is to form an enclosure in which the welding operation is performed. The shield is preferably made of a combustible material such as paper. In the presence of the heat of the arc or due to contact with the electrode, a portion of the paper is burned producing a gaseous atmosphere of carbon monoxide and carbon dioxide within the enclosure defined by the shield. The atmosphere is formed predominantly of carbon monoxide because of the small amount of oxygen present to support combustion within the chamber defined by the shield. The shield is made of paper which does not burn readily, and it has been found that paper loaded with kaolin or clay to be suitable for the purpose. Any paper may be rendered suitable for the purpose by saturating it in a solution of sodium or potassium silicate. During the welding operation some of the clay or silicate included in the paper is deposited upon



the molten weld metal, where it acts as an additional shield for the weld metal.—*June 9th*, 1932.

374,295. June 25th, 1931.—THE CENTRIFUGAL CASTING OF PIPES, W. H. M. Paugh, 101, Columbus-avenue, Sandusky, Ohio.

The inventor says that he has found that for a casting of a given thickness, a certain mould thickness is required, substantially regardless of the outside diameter of the casting; also

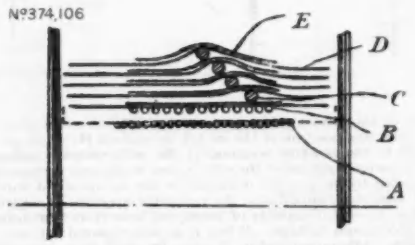


that for castings of different thickness, but of the same outside diameter, different mould wall thicknesses are needed. No proportions are given in the specification, but the two drawings reproduced indicate the relative thickness of the casting A and the mould B. The mould is provided with radial fins so that moulds of various thicknesses can be accommodated in a standard rotor C.—*June 9th*, 1932.

MISCELLANEOUS.

374,106. March 3rd, 1931.—ELECTRIC IGNITION COILS AND SIMILAR SPARK DISCHARGE WINDINGS, the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and Leonard Griffiths, of "Kennington," Biggin Hall-crescent, Coventry.

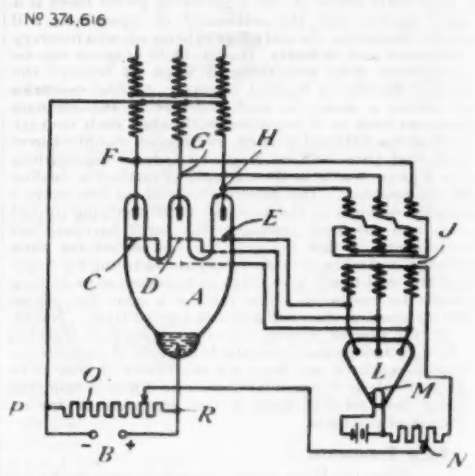
The spark discharge from ignition coils and similar apparatus is, in part, of a highly oscillatory nature. Such high-frequency discharge currents result in excessive potential differences between adjacent turns and layers in the upper or high potential part of the winding of the induction coil, magneto armature or similar device. By increasing the capacitance of the winding, these high potential differences may be substantially reduced, and it has also been proposed to provide a conducting shield in close proximity to, but insulated from, the coil and connected to one terminal thereof, such shield also forming a mechanical protec-



tion. The object of the invention is to provide means for increasing the capacitance of such a winding that is simple and effective, and in which the increase in capacity may be readily controlled. The drawing shows the two last layers A and B of the secondary or high-tension winding. The last layer B may consist of fewer turns but spaced apart. Joined to the end of the last layer is the reinforcing wire C, which is of bare copper and of a larger cross section. This wire is taken, say, four turns round the coil, as shown, and is interleaved with a ribbon of prepared insulating silk D, which is provided with a metal foil facing strip E. The juncture of the reinforcing wire with the coil wire may line on the metal facing and may be insulated from the adjacent layer of the coil by additional insulating ribbon. The capacitance can be controlled by selecting the number of turns of bare wire and metal faced insulation.—*June 6th*, 1932.

374,616. May 29th, 1931.—MEANS FOR CONTROLLING ARC RECTIFIERS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This invention applies to the controlling of arc rectifiers by supplying an A.C. voltage to the control members. A indicates a three-phase mercury vapour glass rectifier which is connected to the secondary terminals of a transformer and supplies D.C. to the terminals B. The control members, in the form of grids C, D, E, are inductively coupled to the anode terminals F, G, H, by means of a three-phase transformer J, so that the grids have a permanently unchangeable lagging of phase with respect to the potential of the corresponding rectifier anodes. For this purpose the primary windings of the transformer J are interlinked in a suitable manner. The grids are connected in parallel with the anodes of an auxiliary rectifier L, which is provided with an incandescent cathode M. The auxiliary rectifier has as its sole load an ohmic resistance. The terminal of the potential divider N is connected to the voltage divider terminal of another ohmic resistance O, which is connected in parallel with the consuming device at the terminals P and R of



the main rectifier. Through both voltage dividers the grids C, D, E receive a negative D.C. biassing voltage. If, for any reason, the voltage at B falls, the biassing voltage at the grids rises simultaneously whereby the current supplied by the main rectifier is increased so that an automatic regulation of the rectifier voltage takes place.—*June 16th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY, JULY 20TH.

INSTITUTION OF MINING AND METALLURGY.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. Special general meeting. "Air Transportation of Gold Dredges in New Guinea," by Mr. Charles A. Banks. 5 p.m. for 5.30 p.m.

THURSDAY, JULY 21ST.

INSTITUTION OF STRUCTURAL ENGINEERS.—General meeting to discuss the revision of the Institution's report, "Steel Work for Buildings: Part 1, Loads and Stresses." 6.30 p.m.

WEDNESDAY, JULY 27TH.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—179th award of certificates. Sir Cyril R. S. Kirkpatrick will present certificates. 3 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Excursion and visit to the works of the Derbyshire Silica Fire Brick Company, Ltd. Depart Manchester by motor coach, 1.30 p.m.

WEDNESDAY, AUGUST 31ST, TO WEDNESDAY, SEPTEMBER 7TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Annual meeting at York. President, Sir J. Alfred Ewing, F.R.S. Particulars may be obtained on application to the secretary, British Association, or to the hon. local secretaries, British Association, The Guildhall, York.

SATURDAY, SEPTEMBER 24TH.

ALL-BRITISH EXHIBITION.—Copenhagen, Denmark. Opening.

TRAINING FOR BUSINESS CAREERS.—The completion of the first teaching year at the Department of Business Administration of the London School of Economics and Political Science (University of London) brings to its close the initial stage of an important experiment in training for business management. The Department was established in 1930, through the joint efforts of leading business firms and the School authorities, and is financed mainly by business subscribers. It provides selected students with full-time training in the broad principles of business administration, and, where necessary, gives as well a preliminary training of a general economic character. In the year just closed twelve students attended the full-time business course, while a further thirteen started the preliminary economic course. Five students were nominated by their firms for full-time study, and a further five were nominated for evening study. Such nominations can only be made by firms subscribing £50 a year or more to the funds of the Department. The remaining students comprised men fresh from the university, a chartered accountant, an ex-Army officer of high rank, and several men with business experience and a good general education. One student was a woman. Training is restricted to students possessing high educational qualifications. In the full day-time course the specialised business subjects comprise marketing, production, and business finance, and deal with statistics and accounting and the principles of *personnel* management from the point of view of executive control. In marketing and distribution, the subjects studied include, for example, buying habits and buying motives of consumers, operating problems of retail and wholesale firms, methods of sales promotion and price policy. A feature of the course was a series of discussions opened by leading business men who gave students the benefit of their own wide experience and first-hand knowledge. Visits to factories, shops, and offices gave similar first-hand contact with business realities. The next course starts in the autumn, and further information, together with application forms, may be obtained from Mr. Jules Menken, the head of the Department, 11, Clement's Inn-passage, W.C. 2.